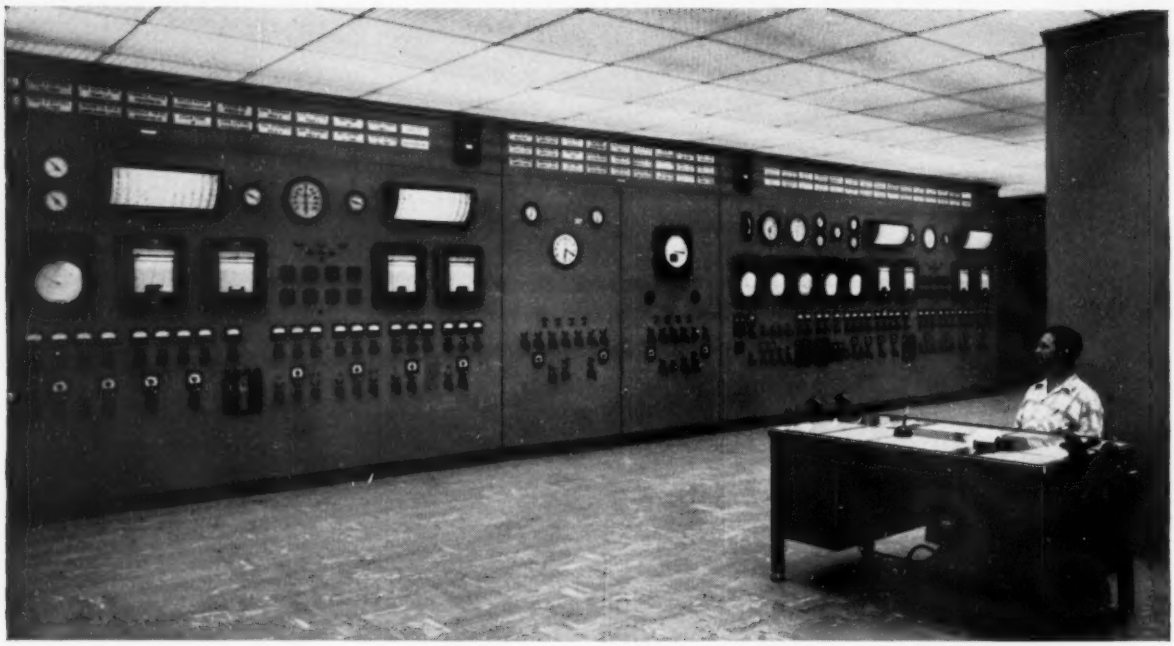
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

March
1953 · 50¢

Practical manual on HARD SURFACING

16 pages



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INSTRUMENTS AUTOMATIC CONTROLS • FURNACES

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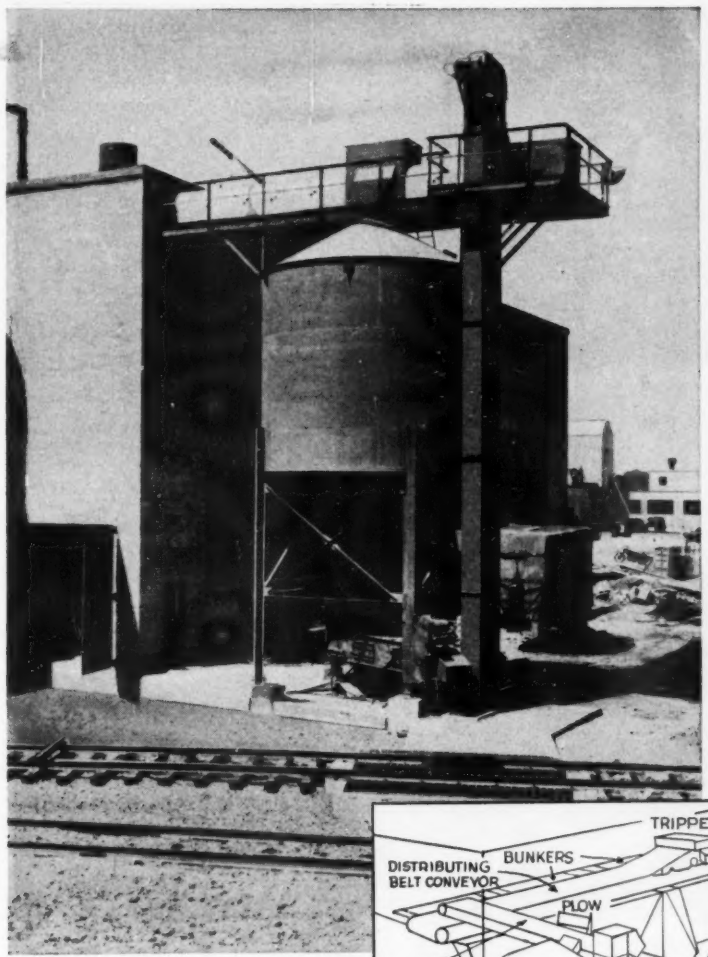

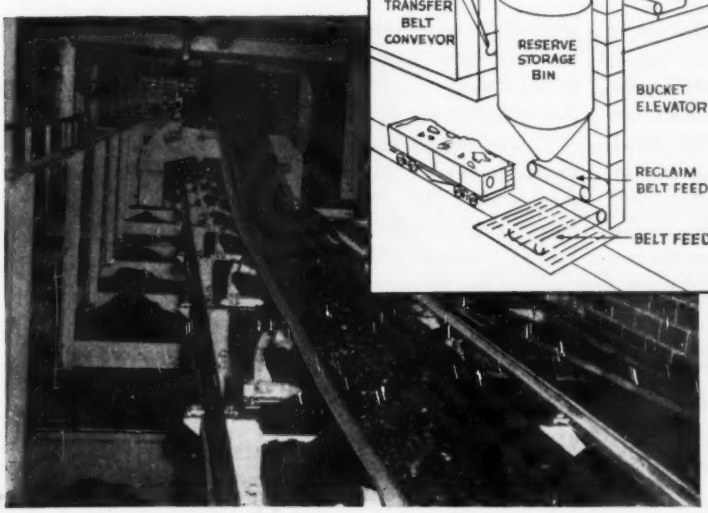

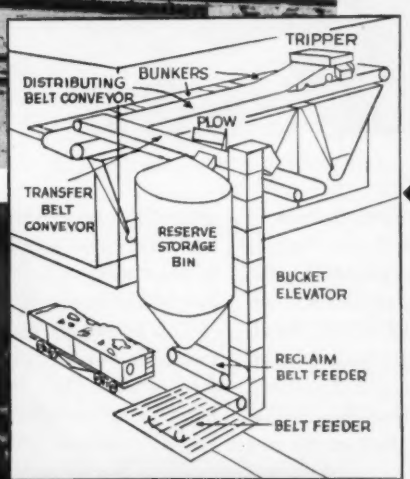

Put LINK-BELT's broad engineering experience plus quality equipment to work for you

As boilers and generating equipment approach their efficiency limits, the one large-scale method to reduce cost per kwh is improved coal handling. That's why Link-Belt's broad engineering experience and complete line of equipment are so important.

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You can see the latest in equipment and system layouts in Link-Belt Book 2410. Ask the engineer in the Link-Belt office near you for a copy. He'll also be glad to show you how this modern planning can cut costs on your particular handling problem.

At A. V. Roe Canada Limited, Malton, Ont., one of Canada's biggest industrial plants, coal moves from track hopper on belt feeder to bucket elevator to transfer belt conveyor. Manually operated plow diverts coal from transfer belt conveyor to reserve storage or allows it to be carried to distributing belt conveyor where tripper discharges it to various bunkers. A second belt feeder reclaims coal from reserve storage bin to bucket elevator.

13,060

LINK-BELT

COAL HANDLING EQUIPMENT

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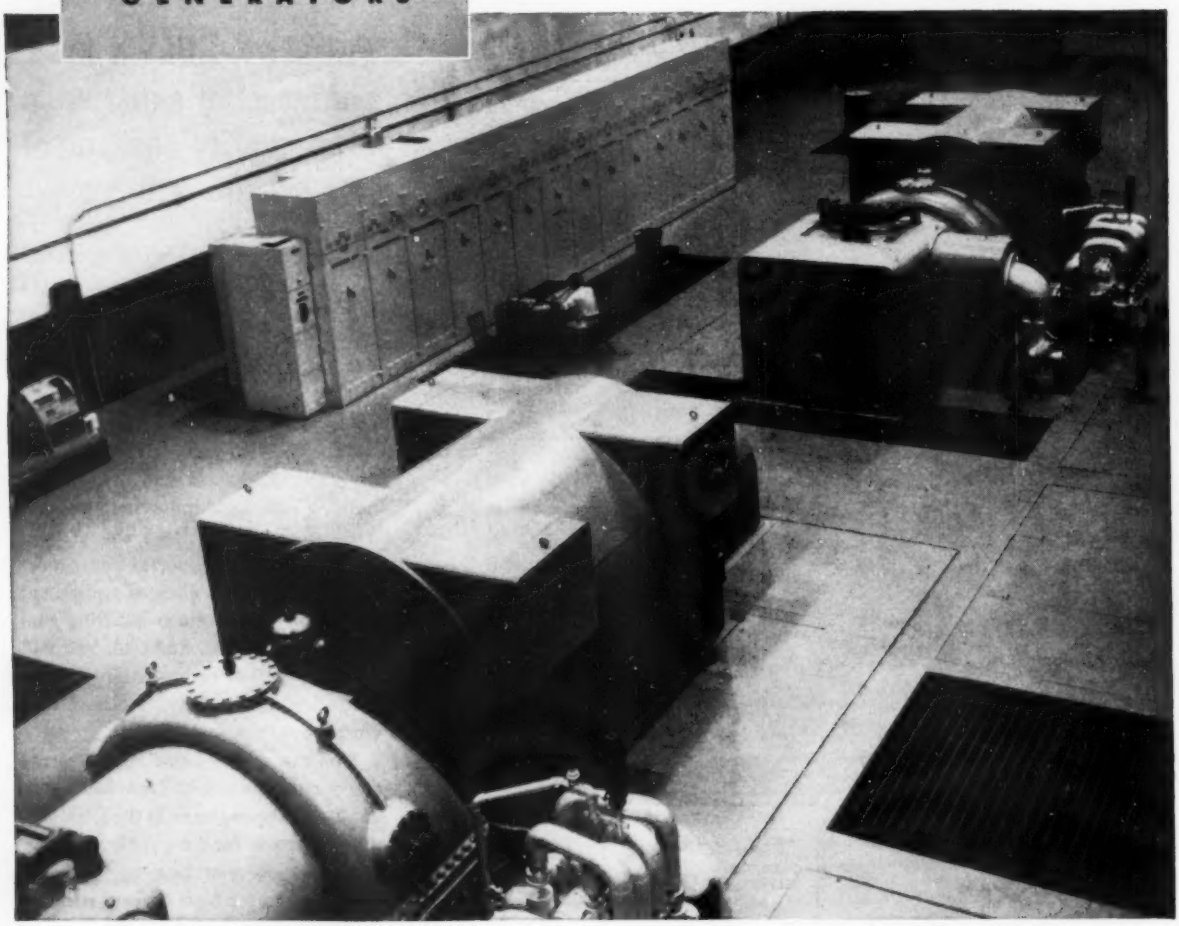
provide more power for Guam



De Laval furnished the Navy Department, Bureau of Yards and Docks, two 11,500 kw De Laval Turbine Generators to supplement power requirements for the island of Guam, headquarters for ship repairs and defense activities in the Pacific. These AIEE-ASME Standard Units operate at 600 psi, 825F. They have been on the job more than a year. Service record? Excellent.

More than a half century of experience lies behind modern De Laval Turbine Generators. In fact, the first unit of this type ever installed in America—in *1893*—had a De Laval nameplate. De Laval engineers are old hands at making turbines that are high on performance, low on maintenance.

You benefit by De Laval's quality design standards in a wide range of other power plant products—boiler feed pumps, IMO fuel oil pumps, circulating water pumps and condensate pumps. Consult your De Laval Engineer on your specific applications.

DE LAVAL *Turbine Generators*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

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Power

MARCH 1953 • VOLUME 97 NUMBER 3

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, which is available for 50¢ from the editorial offices.

HARD SURFACING, ever more widely used maintenance tool, is the timely subject of POWER's second practical manual for readers responsible for plant operation. In its 16 pages (107-122), it tells what hard facing is and does, how to put it to work cutting your own plant's upkeep costs.

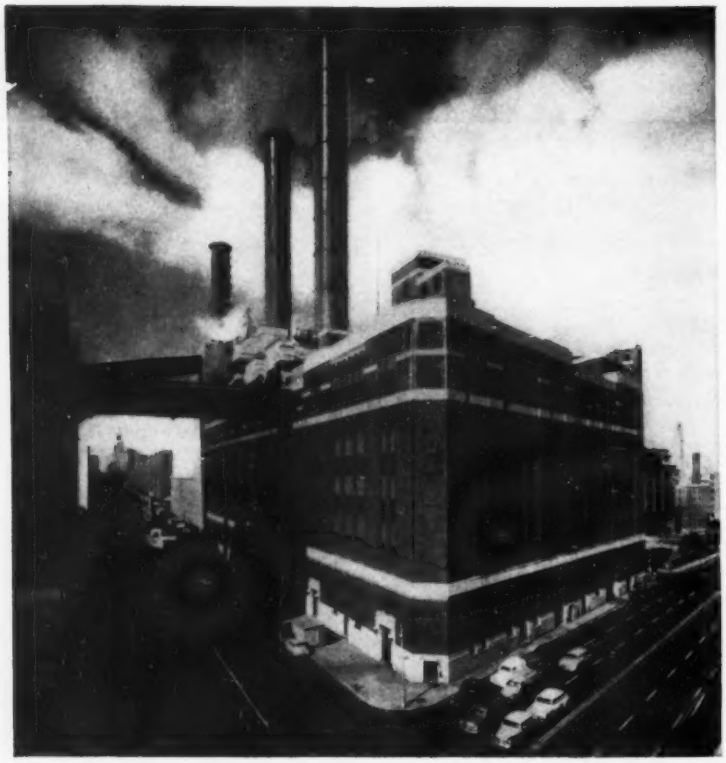
We figured a picture of hard surfacing would make a good cover but didn't realize how good until we saw artist Kent Day Coes' "roughs." Then we became as enthusiastic as he was, couldn't wait to see his finished water color. Watched over by art editor Charlie Marschalek and engraving specialist Eddie Ehrmann, it grew into 4-color plates under the skilled hands of engraving craftsmen in Bingham Photoengraving Co's plant. We're rather proud of the final result, hope you like it too.

Next month . . .

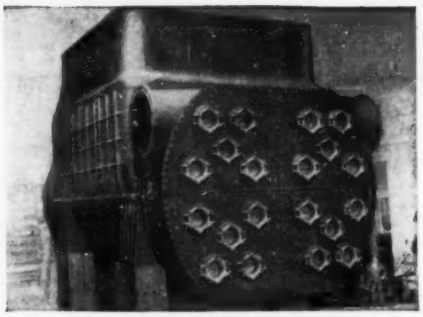
- For answers to your questions on industrial TV, see Jim O'Connor's upcoming roundup. It explains how the various systems work, what TV can do in the plant, some of the factors you need to consider in applying it.
- In paper and textile mills, new ways of trapping Btu's cut fuel cost, as an enlightening article shows. Can such "economizers" help you?
- Top economy in industrial power comes from fitting the right turbine-generators into the right heat balance. An April article on automatic-extraction units tells how to handle the all-important selection job.
- When you build a new plant do you remember past troubles, make sure to avoid them? Matt Jones did just that at Baylor Hospital, tells about the results in next month's PO&M section.
- Judged by our regular reader surveys, you've liked past articles based on Allis-Chalmers slide films. We have another for you—this time on pump selection. Same picture presentation, same practical approach, lots of good pointers on applying pumps.

. . . and future months

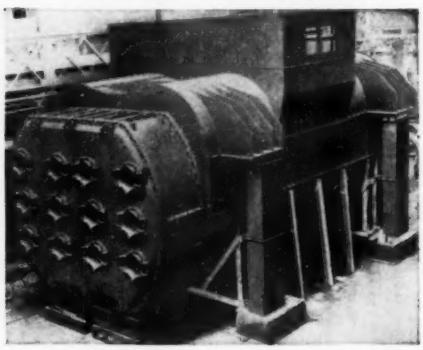
- We're readying a report on atomic energy, summarizing what four industry teams learned in studies under way some time. They're best available picture of commercial-power possibilities.



CON EDISON'S EAST RIVER ELECTRIC GENERATING STATION at 14th Street, New York City, will contain the new Worthington 125,000 sq-ft condenser. The shell, which is to be installed under 160,000-kw Unit No. 7, will contain nearly 105 miles of ¾" O.D. aluminum brass tubes and will require 138,000 gpm of East River water supplied by two 54 in. Worthington "Mixflo" vertical single suction volute circulating pumps.



WORTHINGTON CONDENSER installed in 1931 to serve 160,000-kw Unit No. 7, Hudson Avenue Station. Tube sheets were drilled for 110,000 sq ft with 101,000 sq ft installed.



ONE OF TWO 74,500 SQ-FT 2-PASS WORTHINGTON CONDENSERS serving 60,000-kw Units 14 and 15 at Waterside Station No. 1.

Con Edison once again installs "largest" condenser

On several occasions over the past fifty years, Worthington has been selected to build the "world's largest" surface condensers in single shell design.

In 1919, a 70,000 sq-ft condenser was installed under a 35,000-kw turbine-generator for a prominent utility company. This was the largest single shell surface condenser of its day.

In 1931, Brooklyn Edison Company (now Consolidated Edison Company of New York, Inc.) installed, under 160,000-kw Unit No. 7 at the Hudson Avenue Station, the "world's largest" at that time, a 101,000 sq-ft single-pass Worthington condenser. This was followed, in 1949, by two 74,500 sq-ft condensers for Waterside Station No. 1.

Now, Worthington is again building for Con Edison the "world's largest" single-shell condenser ever ordered, 125,000 sq-ft, single-pass, for the 160,000-kw Unit No. 7 addition to East River Station.

Worthington, with over a century of experience in the manufacture of steam power equipment, is prepared to build efficient condensers in all sizes. Let us advise you, without obligation, on your new installation.

Write, stating requirements, to *Worthington Corporation, Steam Power Division, Harrison, New Jersey.*

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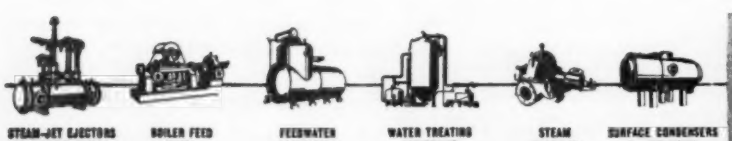

World's Broadest Line of Steam Power Plant Auxiliaries

WORTHINGTON

Condensers

Power

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...with Power readers...

CAN YOU HELP? . . .

A few years ago POWER published two articles called "Fluid Highways."

I am very much interested in these and would like to obtain these two publications. Would you be kind enough to advise me as to how this can be accomplished?

Sault Ste Marie, Ont. G A EDWARDS

The items requested by Reader Edwards (no relation to our George Edwards, by the way) originally appeared in Dec and Mid-Dec 1937. Our stock of reprints has been completely exhausted for many years. Perhaps you have a spare copy, or one you no longer need.

If you do have one, and want to help fellow-reader Edwards, send it to him c/o Algoma Steel Corp, Ltd, Sault Ste Marie, Ontario, Canada.

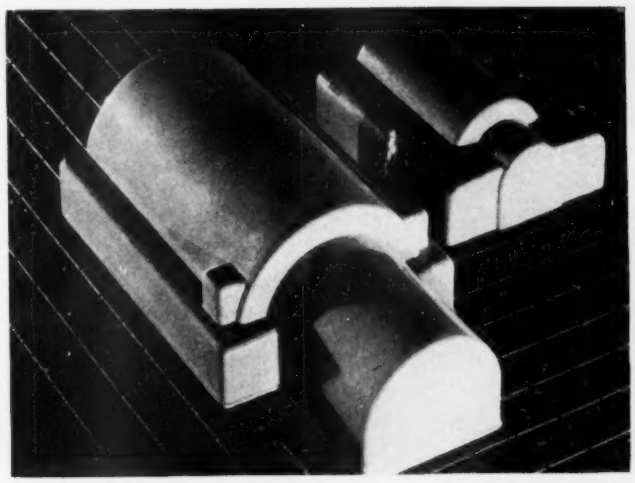
Incidentally, you can get a listing of POWER *special sections and reports that are available by just dropping us a card.*

MORE ON H-T HOT WATER . . .

I have studied with interest the article on high-temperature water in your Jan issue (pp 96-98) and while, in some respects, the methods advocated are in keeping with

(*Continued on page* 216)

...lines and bylines



Standard hydrogen-cooled generator, much smaller "supercharged" twin

PROOF OF THE PUDDING would be a good title for this picture, we think. Here's why: Back in Nov 1951 (pp 162, 164) POWER reported a big step forward in the art of hydrogen cooling. Called "supercharging," this idea involves forcing hydrogen at high velocities through the generator conductors, where the heat originates. It promises drastic reduction in physical size of generators, making it possible to visualize much greater capacities in a single unit than ever before.

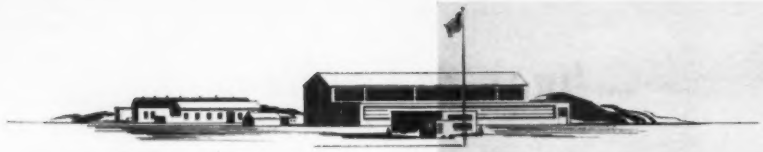
One fulfillment of the promise can be seen in the scale models photographed above. By this dramatic comparison, Allis-Chalmers engineers show what happens to the size of a standard hydrogen-cooled generator when supercharged cooling is applied to *both* rotor and stator. And, we might add, a new excitation system cuts down the size of the exciter as well.

We like this picture because it demonstrates an important thing about technical magazines in general and our favorite magazine in particular. A big, and exciting, part of our job is running down the significant new developments in the power field and keeping you continuously informed of them. And this photo reveals, far better than words, how such developments pay off.

Howard McCall

CHASING BTU's isn't much like chasing a tennis ball, but Howard McCall manages to do well at both. A ranking tennis player, he's also a top-drawer specialist in heating, ventilating and drying. First with Sturtevant Division of Westinghouse, and now as industrial engineer with J O Ross Engrg Corp, Howard has piled up a lot of know-how in the art of making each Btu deliver full value. He passes along some of this savvy on pp 84-85.

Twin interests in sports and engineering got off to a flying start at Georgia Tech, but were interrupted by a stint as an ensign in the U.S. Navy. Back in civvies, Howard resumed competitive tennis, secured his professional engineer license, became a member of ASHVE and the Georgia Engrg Society. Now married, he admits to some new interests—gardening and being proud father to three youngsters.



From B&W Research and Development . . .

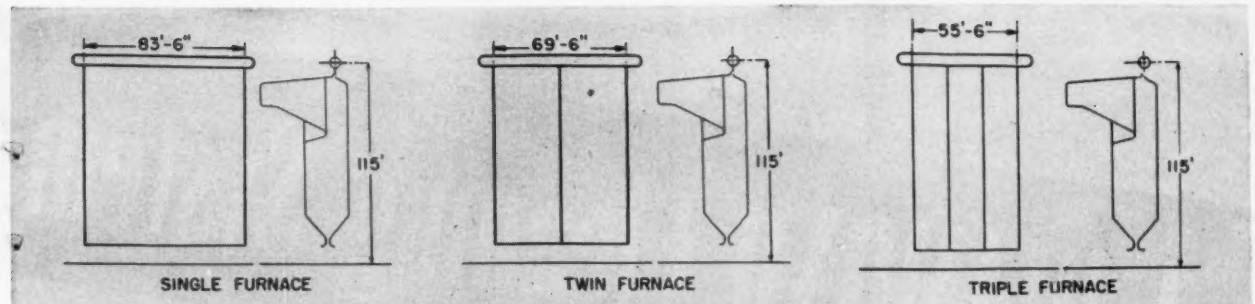
a practical solution to cost problems...

B&W DIVIDED

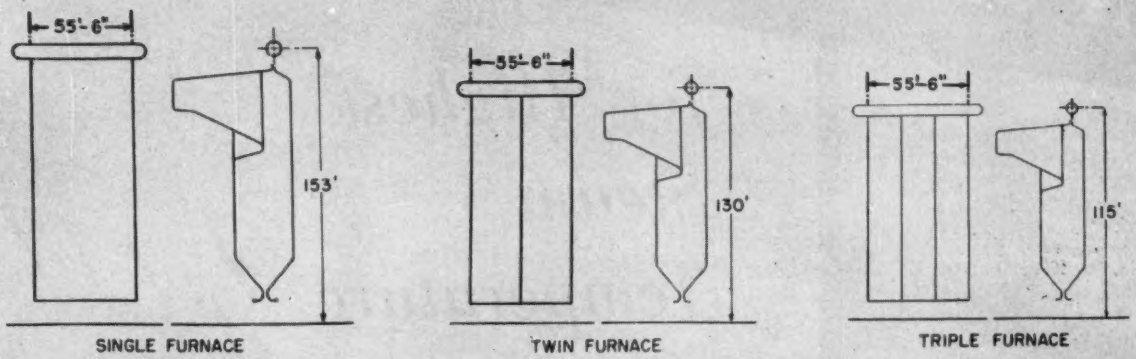
A practical, long-proved solution to rising construction costs may be found in the B&W Divided-Furnace Boiler. Whether it is a problem of conserving height, width, or both—especially for units with large heat input—B&W's Divided-Furnace design offers remarkable economies. The sketches on the opposite page show typical savings in space for twin-furnace and triple-furnace construction as compared with single-furnace construction.

A furnace division wall receives heat from both sides and therefore must be assured an adequate supply of water. With the B&W Cyclone-Steam Separator, circulation in division walls of B&W boilers has always been more than ample—as proved by long-term central station operation at boiler design pressures as high as 2650 psi. Many years of experience stand behind B&W's Divided-Furnace construction with all types of large units—Radiant, Stirling, and Open-Pass. Over 75 B&W Divided-Furnace Boilers are in operation—many for over 10 years—and more than 80 units are under construction, for the following electric utilities:

Alabama Power Company • Appalachian Electric Power Company • Arkansas Power & Light Company • Cincinnati Gas & Electric Company • City of Los Angeles • Cleveland Electric Illuminating Company • Commonwealth Edison Company • Consolidated Edison Company of N. Y. Inc. • Consolidated Gas, Electric Light & Power Company of Baltimore • Dallas Power & Light Company • Detroit Edison Company • Duquesne Light Company • Electricite France • Georgia Power Company • Houston Lighting & Power Company • Indiana & Michigan Electric Company • Jersey Central Power & Light Company • Kentucky Utilities Company • Long Island Lighting Company • Middle South Utilities, Inc. • Monongahela Power Company • Niagara-Mohawk Power Corp. • Northern Indiana Public Service Company • Ohio Edison Company • Ohio Power Company • Pacific Gas & Electric Company • Pennsylvania Electric Company • Philadelphia Electric Company • Public Service Company of Colorado • Public Service Company of Northern Illinois • Public Service Company of Indiana Inc. • Public Service Company of Oklahoma • Public Service Electric & Gas Company • Southern California Edison Company • Tennessee Valley Authority • Texas Electric Service Company • Texas Power & Light Company • Toledo Edison Corp. • Union Electric Company • West Penn Power Company • Wisconsin Power & Light Company



EFFECT OF DIVISION WALLS ON BOILER WIDTH—KEEPING HEIGHT CONSTANT



EFFECT OF DIVISION WALLS ON BOILER HEIGHT—KEEPING WIDTH CONSTANT

FURNACE

Division wall furnace construction is used in combination with other significant achievements of B&W Research and Development, including the Cyclone Furnace, Pressure-Firing, Gas Recirculation, and improved alloys for high steam temperatures. Widely accepted throughout the power industry, these modern B&W advances are making major contributions to more economical and reliable steam generation.

B&W's continuing program of progressive research combined with its broad experience in designing and building boilers with the highest capacities in existing pressure-temperature ranges, assure you of the most efficient and economical solutions to your specific steam generation problems.

ADVANTAGES OF DIVIDED FURNACE CONSTRUCTION

- Provides greater cooling area without increasing furnace volume
- Reduces steel and other material costs by keeping boiler and building volume to a minimum
- Lowers furnace construction costs
- Cuts operating costs by reducing slagging in furnace and in convection surface

Triple furnace boilers for 1 boiler—1 turbine units of over 200,000 KW capacity are now being constructed

BABCOCK & WILCOX

G-5697

A DIAMOND Cleaning System

for Highest Steam Temperature Yet!!!

Kearny Goes to 1100°F Steam Temperature *plus reheat*

For this most important unit, a DIAMOND CLEANING SYSTEM has been selected to assure optimum efficiency and continuity of operation. High superheat and reheat temperatures must have *positive* and *uniform* cleaning to assure *safe* metal temperatures. Diamond equipment and experience meet this requirement in every respect: economy, reliability, and serviceability.

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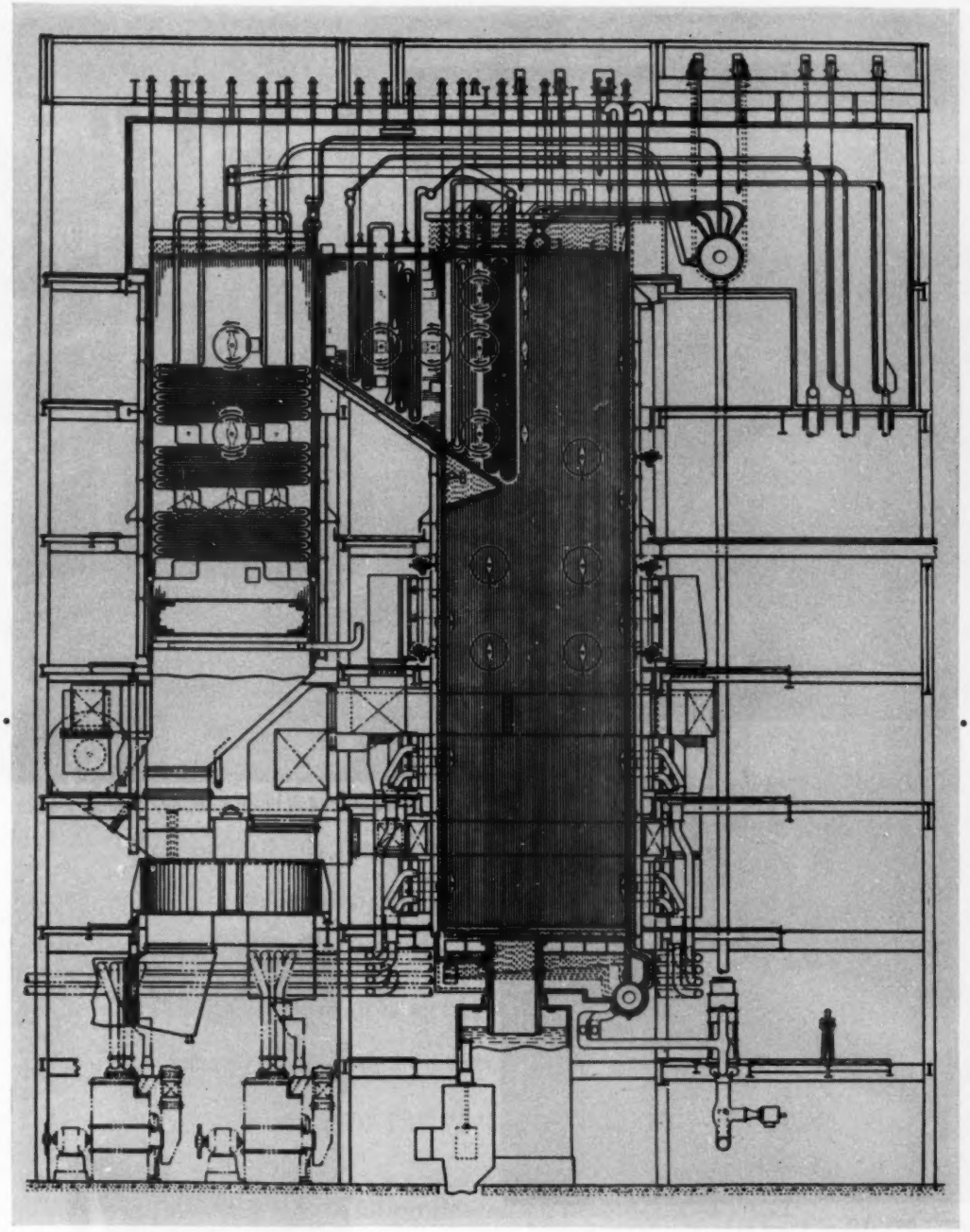


Kearny Generating Station
PUBLIC SERVICE ELECTRIC
AND GAS COMPANY

50th ANNIVERSARY
1903-1953

DIAMOND POWER SPECIALTY CORPORATION

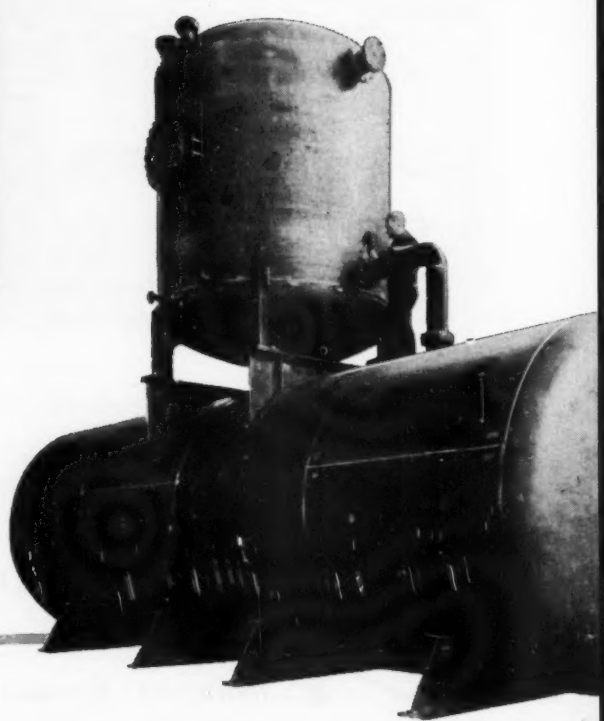
LANCASTER, OHIO

Diamond Specialty Limited • *Windsor, Ontario*

Assembly line in Elliott Company welding shop.

THE LATEST DESIGN *of Elliott deaerating heater incorporates this stainless steel vent collecting hood, which with the inlet spray assembly is located inside the shell at the top. This replaces the former tubular vent condenser located outside the shell in older designs, requires no maintenance beyond occasional inspection, and simplifies headroom problems.*

At right, a 975,000-lb-per-hr Elliott vertical deaerating feedwater heater, mounted on its storage tank, set up for final testing in the Elliott shops. A notable feature is that stainless steel is used throughout wherever there is contact with corrosive water. This includes the trays which are of fabricated stainless steel and light in weight.



deaerating heaters ELLIOTT does the whole job!

Users of Elliott deaerating heaters enjoy the assurance that the entire construction of each unit is Elliott shop-built all the way through. No responsibility for any part of the construction is delegated to an outside organization. Elliott quality is rigidly maintained right from the bending of the first plate to the welding of the last inch of joint. The entire unit is set up, hydrostatically tested, dismantled, and loaded on flatcars for shipment. At no time has the heater or any part of it, been outside the Elliott plant.

For full details on Elliott deaerating heaters, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

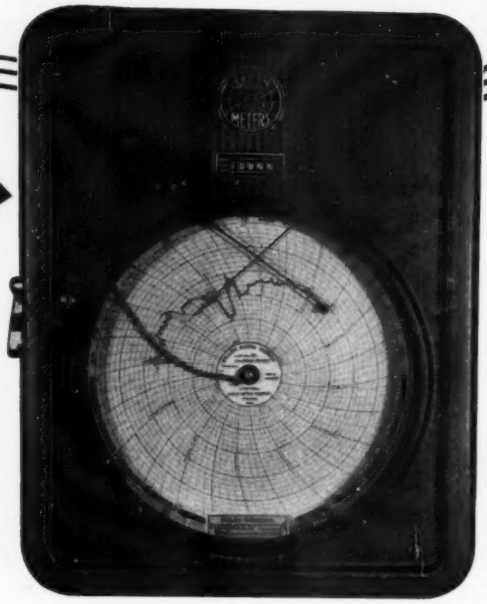
N3-1

ELLIOTT Company

DEAERATOR AND HEATER DEPARTMENT

To Answer Your

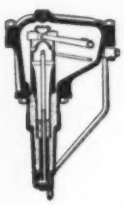
LOOK HERE



This standard Bailey Recorder actuated by mechanical, electrical, or pneumatic transmission solves even your toughest problems in flow measurement and control.

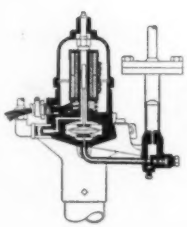
YOUR Choice of 7 Measuring Components:

...To measure steam, liquids, or high pressure gases in pipes use:



1 Ledoux Bell—

This shaped bell floating in mercury insures high accuracy and dependability throughout entire meter range. Records on uniformly graduated chart. For static pressures up to 2500 psig.



2 Mercury Float—

Actuates electric transmitter which has interchangeable range tubes. Electronic receiver records on uniformly graduated chart. For static pressures up to 2500 psig.

3 Bellows—

Actuates electric transmitter which requires no mercury, is readily portable and is easily adjustable to a wide variety of ranges. Electronic receiver records on uniformly graduated chart. For static pressures up to 3500 psig.

Bailey Meter Company

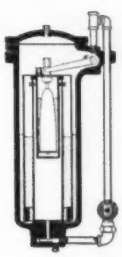
Flow Problems

...To measure liquids in pipes use:

4 Area Meter—

Variable area constant differential orifice actuates electric transmitter. For 1, 2 or 4″ lines in capacities from 1200 to 96,000 lb per hour and static pressures up to 600 psig.

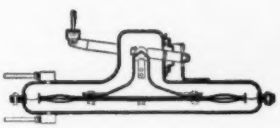
...To measure low pressure gases in pipes and ducts use:



5 Inverted Bell—

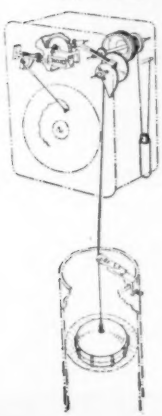
Sizes up to 12″ diameter furnish ample power with differentials as low as 2″ H_2O. Shaped displacer floating in mercury provides for uniformly graduated chart. Static pressure limits vary from 50 to 800 psig, depending upon bell size.

6 Diaphragm—



44 square inches in area opposed by shaped displacer floating in mercury actuates uniformly graduated chart recorder. Suitable for differentials from .5″ to 7″ H_2O and static pressures up to 70″ H_2O.

...To measure liquids in open channels use:



7 Open Float—

Actuates uniformly graduated chart recorder through pulley-operated cam and gear train. May be calibrated to any maximum head between 5″ and 360″ of liquid flowing in channel.

•

Ask your local Bailey Engineer to assist you in applying Bailey Meters to your measurement and control problems.

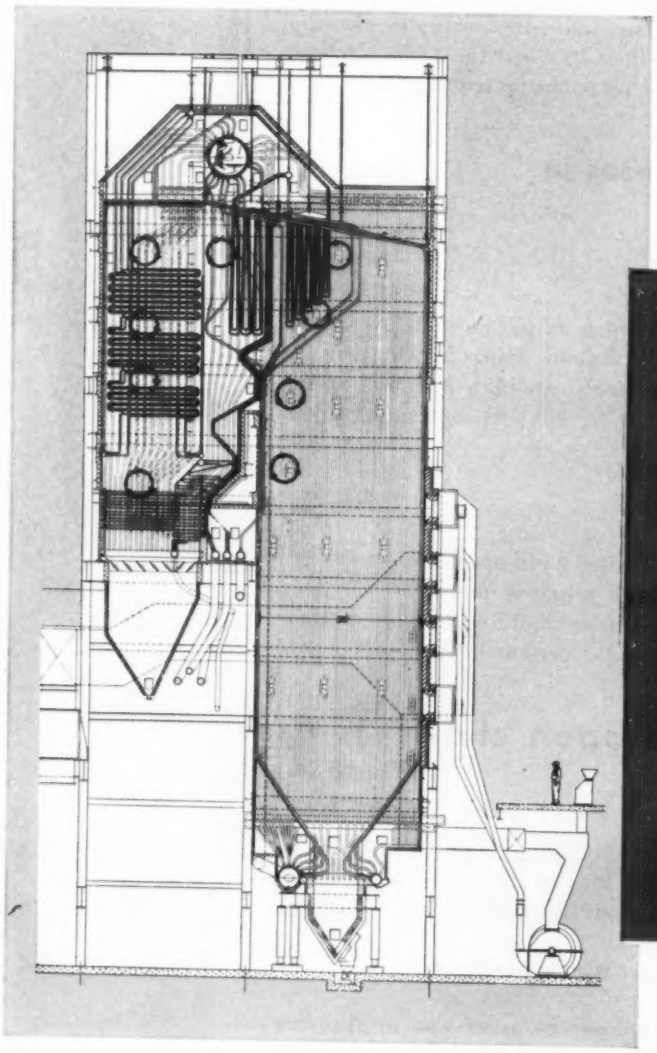
C-8

Meters and Controls For Power and Process

1036 Ivanhoe Road
CLEVELAND 10, OHIO

VULCAN SELECTED FOR UTAH POWER &

AUTOMATIC
Unit 2 is all



BOILER DETAILS

Reheat Steam Generator, Riley Stoker Corp.

Maximum Capacity . . . 575,000 lb per hr

Superheater Outlet Pressure . . . 1525 psig

Primary Steam Temperature . . . . . 1000 F

Reheat Steam Temperature . . . . . 1000 F

Fired with Petroleum pitch and Pulverized coal

Soot Blowing . Vulcan Automatic Sequenced System with electric-driven long retractables blowing with steam controls for air-heater cleaning

Consulting Engineers . . Bechtel Corporation

VULCAN *Automatic*

REHEAT STEAM GENERATOR AT
LIGHT COMPANY, GADSBY PLANT

SEQUENTIAL SYSTEM *for* electric . . . all outdoors

Electric-driven Vulcan long-retractable soot blowers, with electric automatic sequential control of the cleaning operations, have been selected for Unit 2 at Gadsby Plant.

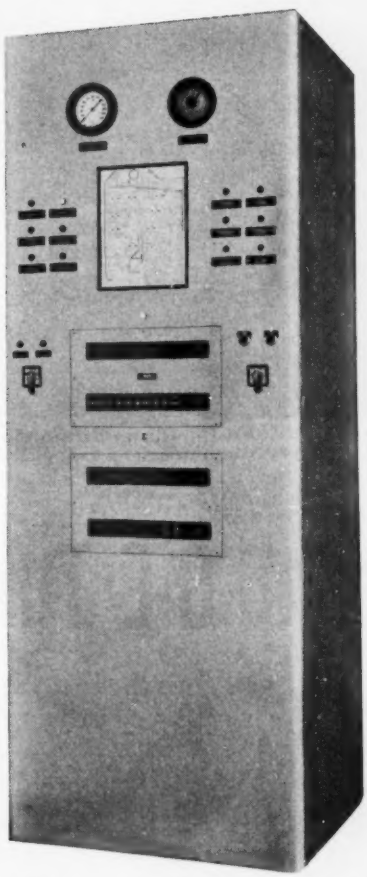
Electric drive may seem to cost more than air, but it needs no added compressor capacity. Cleaner and quicker, it operates more smoothly and at lower cost. It has a more dependable power supply. And in outdoor installations, it has no control-air lines to freeze in winter weather.

Vulcan long retracts effectively clean the most inaccessible areas, even with travels over 25 feet.

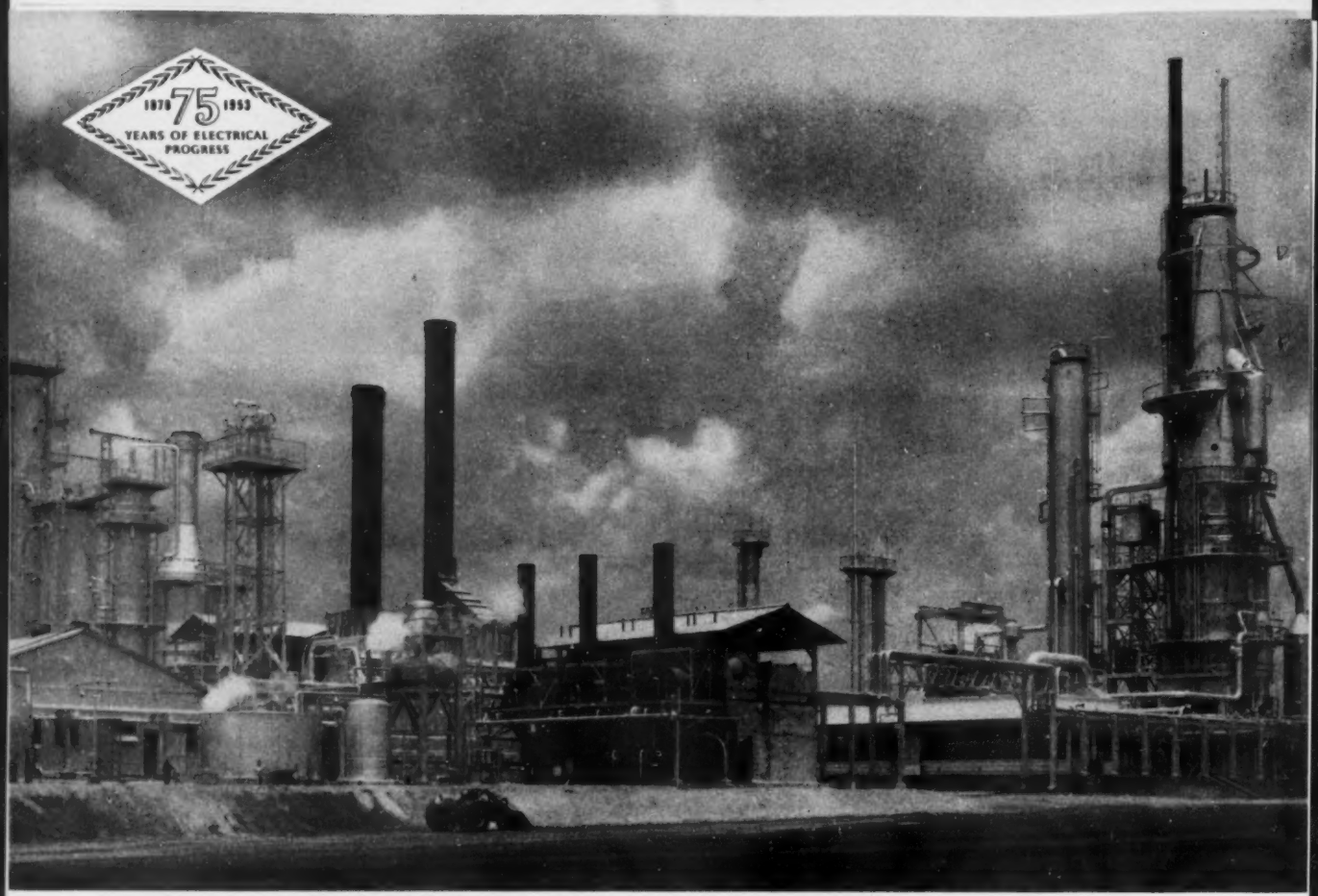
And Vulcan Automatic-Sequential Control makes cleaning a simple matter of pushing a button at a central panel. There is no need to patrol the boiler, for the entire operation is reported visually.

Large or small, utility or industrial, power or process—your boilers can be cleaned better and at lower overall cost by Vulcan Automatics.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

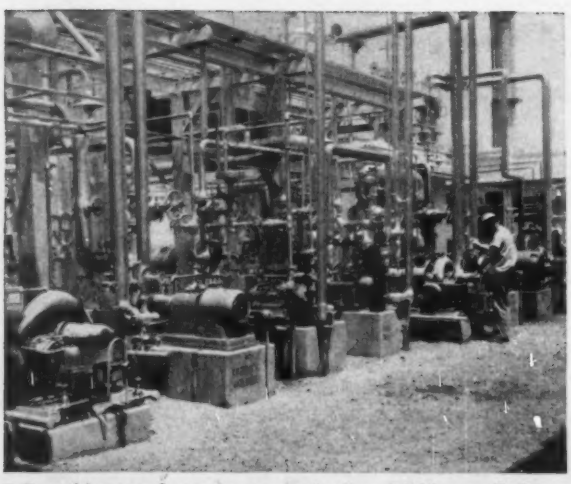


Operation of each blower is reported back to this central panel, where the operator merely flicks his wrist to start the automatic or selective sequence, or to work a single blower manually.

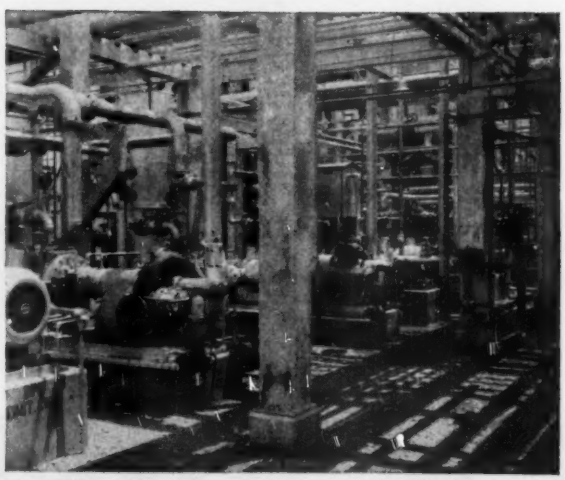


McMurrey Refining Company, Tyler, Texas, installed G-E mechanical-drive turbines throughout their plant to help assure continuous capacity output of 5000 bbls. per day.

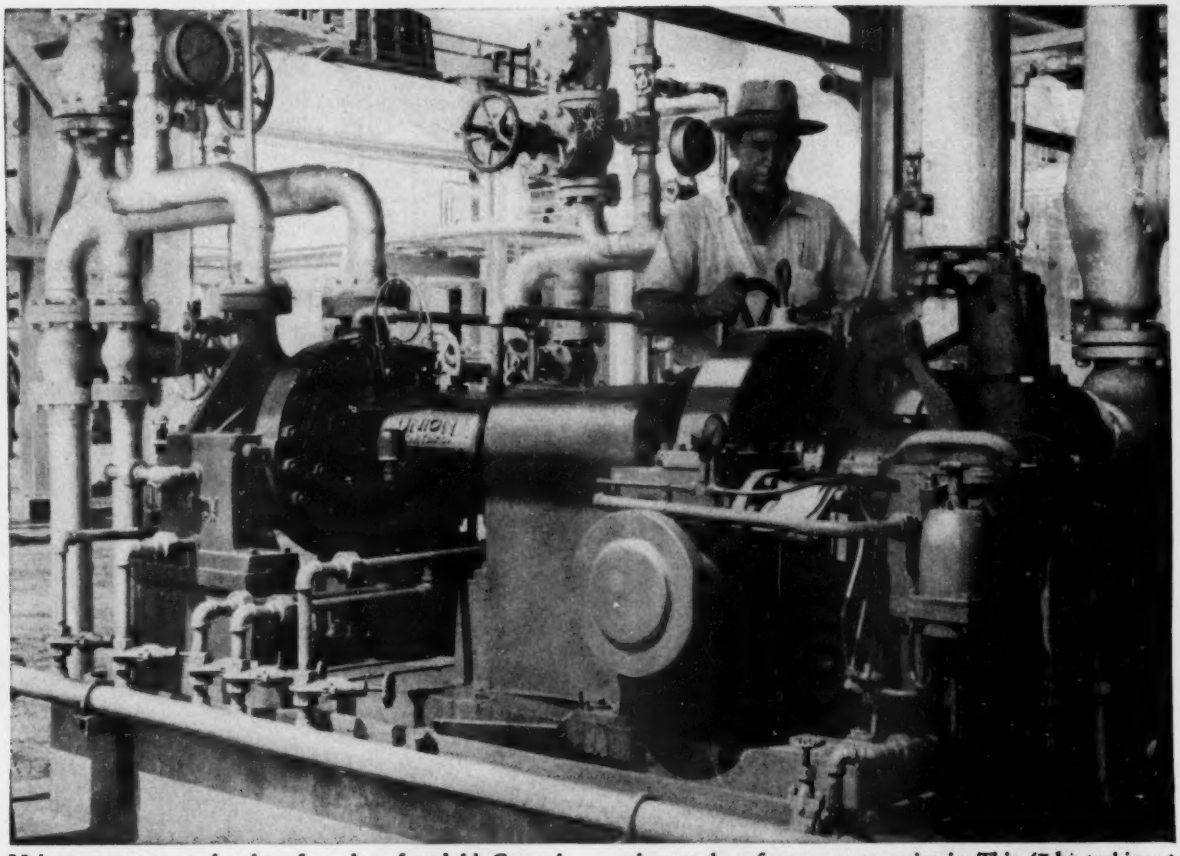
G-E Turbines Save Maintenance,



G-E turbines and motors are paired at McMurrey Refinery to utilize large steam supply efficiently. When process steam demands decrease, surplus steam is economically diverted to turbine drives. These Type DP turbines range from 8 hp to 41 hp.



Shown here is part of a row of ten General Electric Type DP turbine drives and motors, ranging from 9 hp to 48 hp. The many interchangeable parts on these turbines make stocking of spare parts an economical matter.



Maintenance personnel at the refinery have found this General Electric Type DP mechanical-drive turbine, like the many others at the refinery, easy to maintain. This 47-hp turbine at McMurrey Refinery drives a boiler-feed water pump.

Inventory Costs at McMurrey Refinery

Installed to improve steam balance, G-E standard turbines, with many interchangeable parts, also cut inventory costs.

The McMurrey Refinery, Tyler, Texas, installed General Electric mechanical-drive turbines to help regulate steam balance. Since process steam demands range from 30% to 70% of available supply, surplus steam is economically diverted to turbine drives.

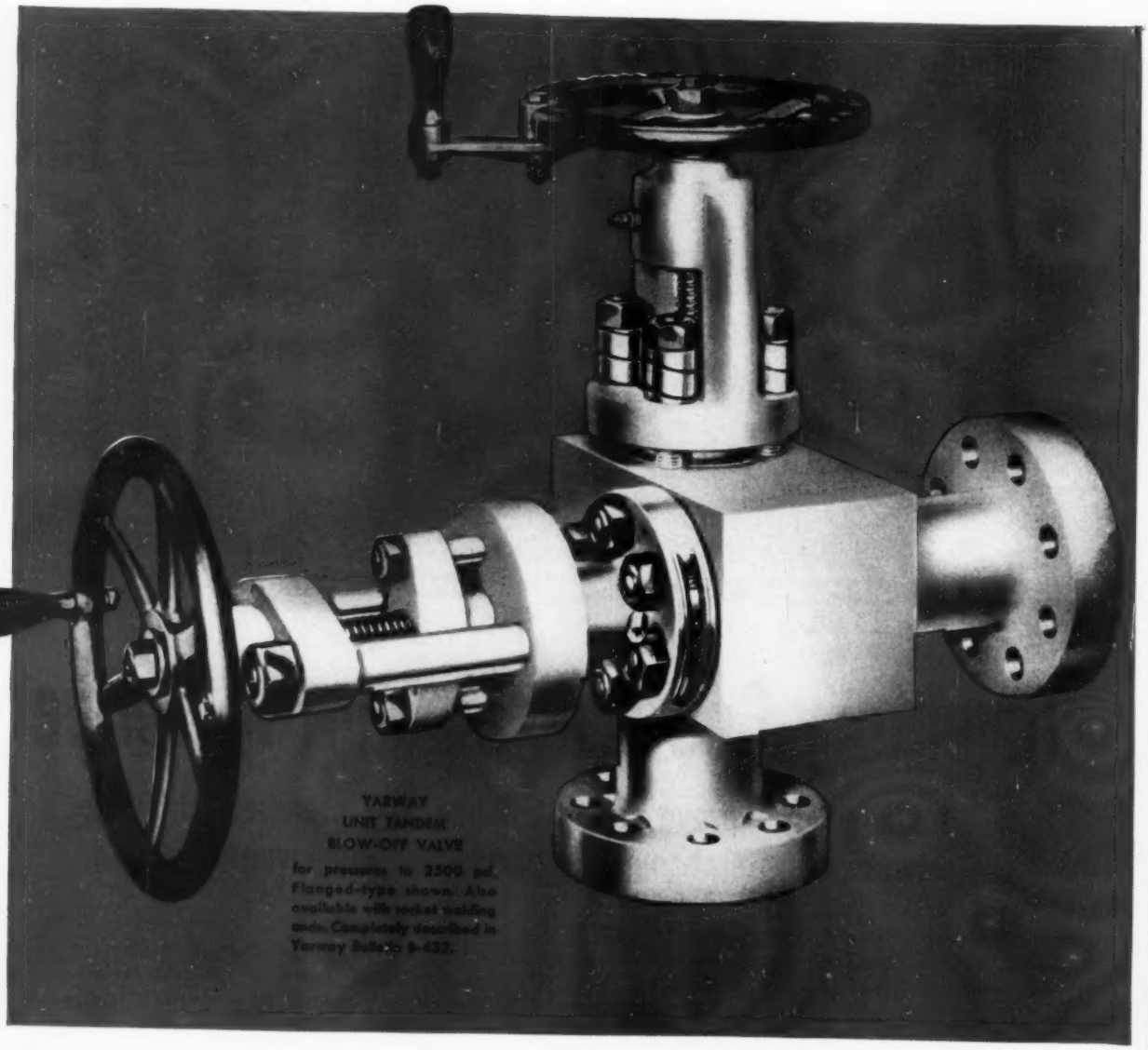
Time soon proved that General Electric turbine drives have many other advantages. Mr. Dave Hood, Mechanical Maintenance Foreman at the refinery, states, "With these turbines on the line now for over a year, we're happy to report that they are extremely easy and economical to maintain, requiring very little of our time for maintenance."

Mr. Hood also said, "Since we have quite a few different sizes and ratings of turbines here, we're particularly pleased with the great number of interchangeable parts on these turbines. It certainly cuts down our inventory problem." Interchangeability of a great majority of the replaceable parts (regardless of hp rating) is a big feature with G-E standard turbine drives, which are paired with motors throughout the refinery to help assure uninterrupted service.

Call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-59, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

YOUR BOILER



YARWAY
UNIT TANDEM
BLOW-OFF VALVE

for pressures to 2500 psi. Flanged-type shown. Also available with socket welding ends. Completely described in Yarway Bulletin B-432.

YARWAY®

IS WORTH A

BLOW-OFF VALVE

Boilers represent sizable investments . . . certainly worth protecting with the most dependable boiler trim you can get.

You need good blow-off valves—valves that keep blow-down lines tight, don't wear, clog or leak, and are rugged enough to stand up under the severe shock of regular or emergency blowing-down under pressure.

Yarway Blow-Off Valves meet those requirements. Both Yarway Seatless Valves with balanced sliding plunger, and Yarway Stellite-faced Hard-Seat Valves embody the most recent developments in design and metallurgy.

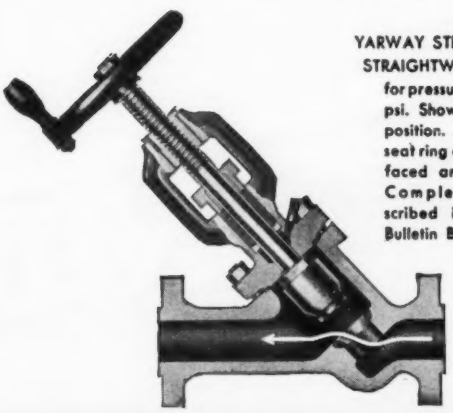
Engineers tell us the sturdiest of all blow-off valves is the Yarway Unit Tandem. This famous valve combines either a seatless and hard-seat, or two hard-seat valves, in a one-piece forged steel body. It is made for pressures up to 2500 psi. Other Yarway Blow-Off Valves meet lower pressure requirements.

It is significant that more than 15,000 plants throughout the world use Yarway Blow-Off Valves . . . and among the higher pressure plants, 4 out of every 5 are Yarway-equipped!

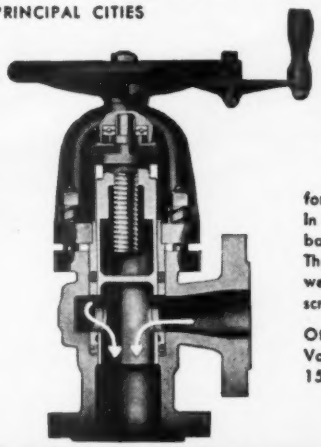
A Yarway bulletin will tell you in detail how these valves can protect *your* boiler investment. Write today, stating pressure range.

YARNALL-WARING COMPANY, 100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

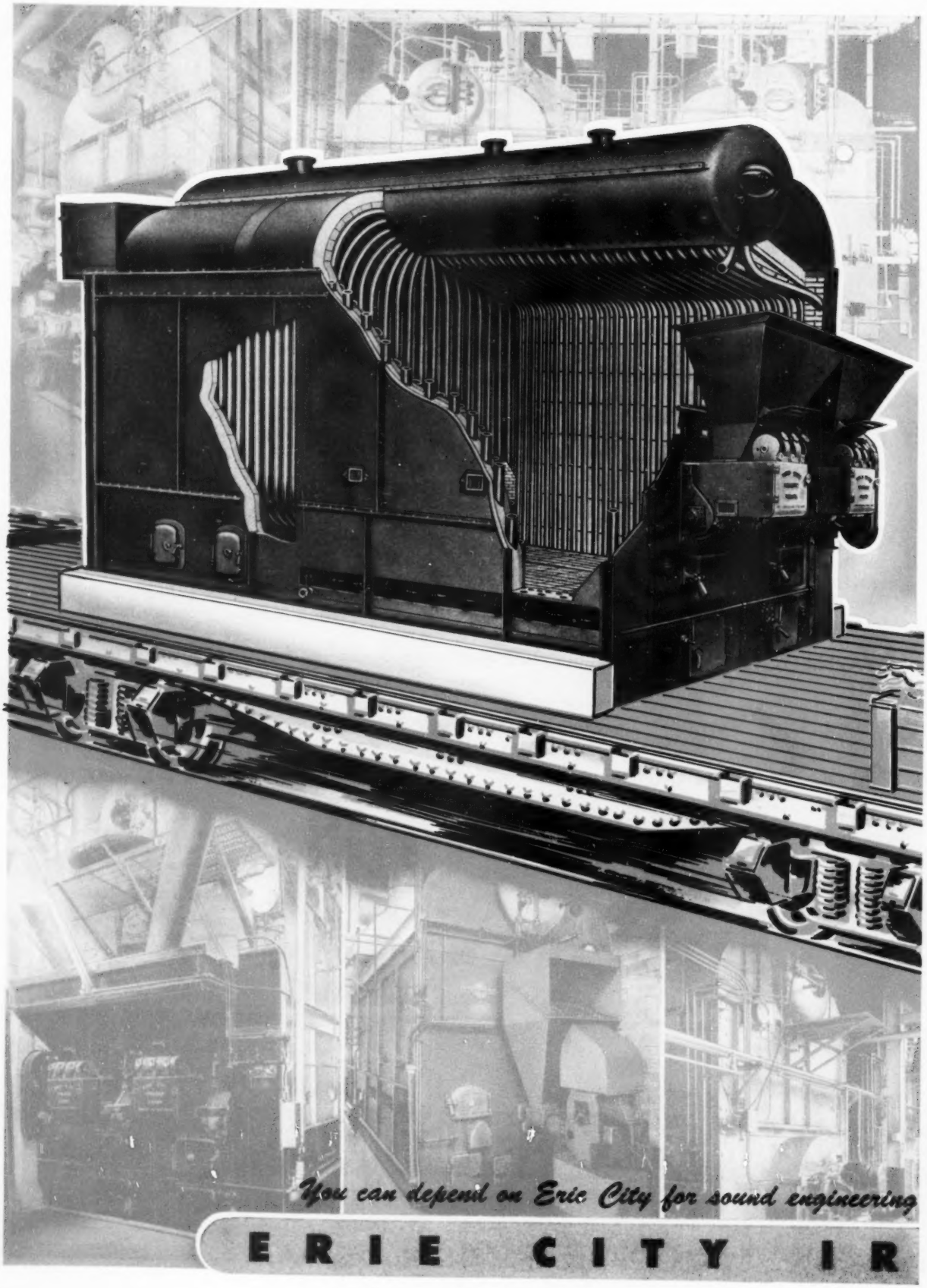


YARWAY STELLITE-SEAT STRAIGHTWAY VALVE for pressures to 2500 psi. Shown in open position. Disc and seat ring are stellite-faced and ground. Completely described in Yarway Bulletin B-432.



YARWAY TYPE "B" SEATLESS ANGLE VALVE for pressures to 400 psi. In open position. Notice balanced sliding plunger. There is no seat to score, wear, clog or leak. Described in Bulletin B-424.

Other Yarway Seatless Valves for pressures to 1500 psi.


You can depend on Erie City for sound engineering
ERIE CITY IR

Here's Another

ERIE CITY VL STEAM GENERATOR

Stoker and 300 hp. VL boiler are shown combined but are shipped as two units.

This one, fired by the Erie City Dumping Grate Spreader Stoker. Erie City VL's by the hundreds are serving a broad cross section of small to large steam users. These completely factory-assembled or field erected steam generators incorporate a 2-drum boiler and integral water cooled furnace for any mechanical firing method. We draw upon a 50 year experience with 2-drum boilers and a pioneering application of water wall design that keeps refractory maintenance to a minimum.

Only clean water can enter the integral water wall circulation. VL's are the most accessible boilers of this type—easy to keep clean and at top efficiency. Hospitals, Schools, Institutions, Dairies, Laundries, Industries and Process Plants use and repeat on VL's.

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

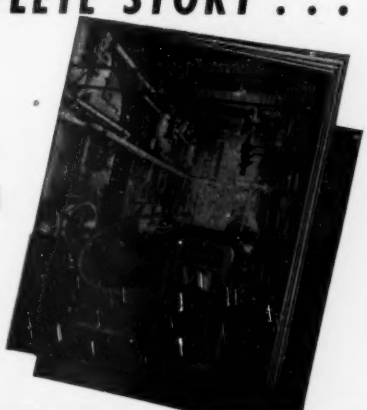
A Few of the Hundreds of Erie City VL Users

BORDEN CO.
DAIRYMAN'S LEAGUE
ARMOUR & CO.
KRAFT FOODS CO.
GENERAL MILLS CO.
REPUBLIC STEEL CORP.
BORG WARNER CORP.
ALUMINUM CO. OF AMERICA
GENERAL ELECTRIC CO.
UNION PACIFIC R. R. CO.
HERCULES POWDER CO.
ARCHER DANIELS MIDLAND CO.

Get the COMPLETE STORY . . .

on this modern 2-DRUM Steam Generator for all mechanical firing methods.

Ask for **SB-43A**



O N W O R K S • *Erie, Pa.*

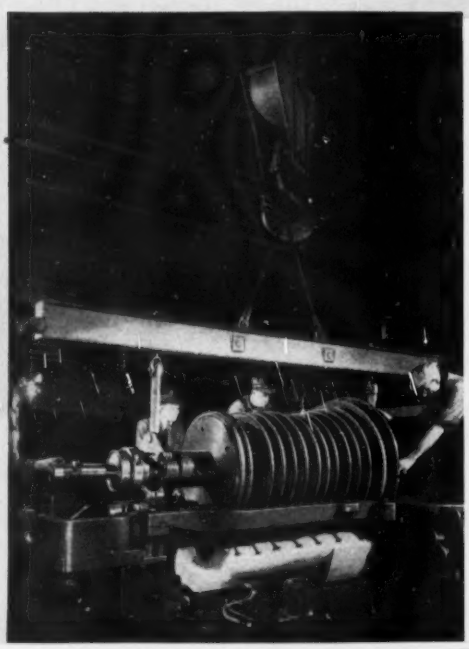
From Shop

HERE'S HOW Allis-Chalmers Builds the Generator Unit that's Easy to Install, Low in Foundation Cost

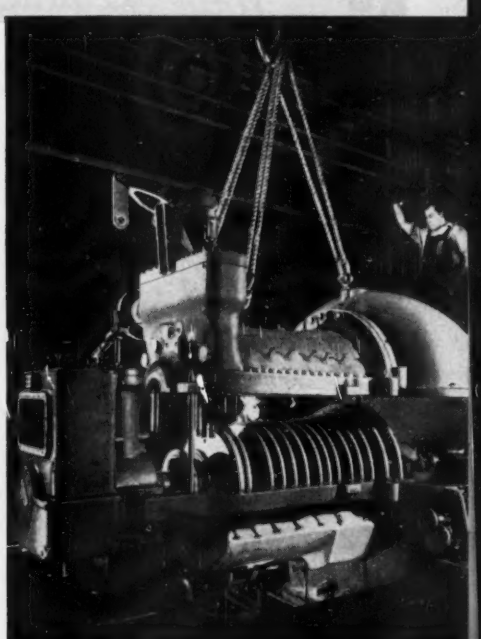
MODERN Allis-Chalmers WA-Series steam turbine generating units are factory tested and shipped with rotors locked in place to save you installation time. Oil piping and generator air coolers are both above the floor line to reduce your foundation costs.

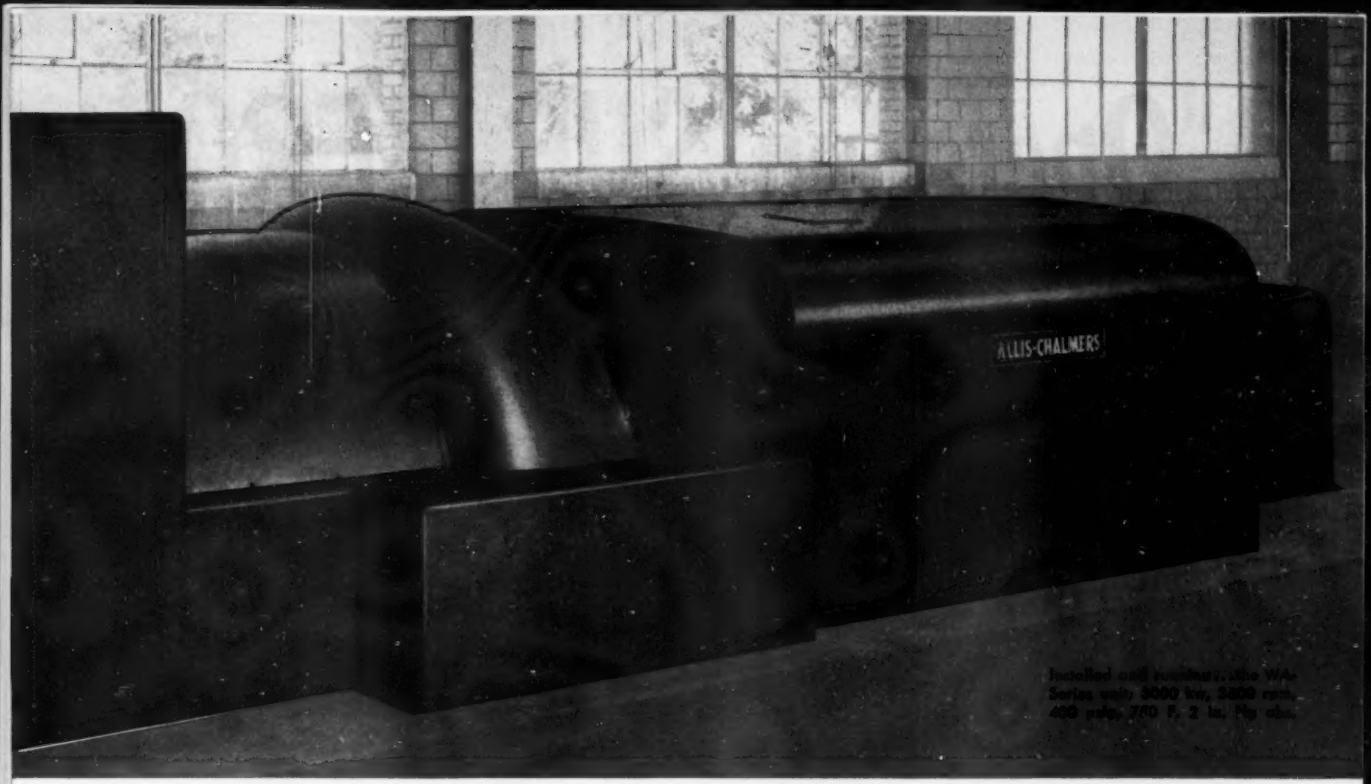
WA-Series units are built in ratings from 2000 to 7500 kw for either condensing or non-condensing operation. For your copy of Bulletin 03B7654, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3910

1 Precision balanced turbine rotor assembly being lowered into casing. All wheels have durable chrome alloy steel buckets.



2 Upper half casing of this compact impulse steam turbine is next added in the process of assembling the WA-Series unit.

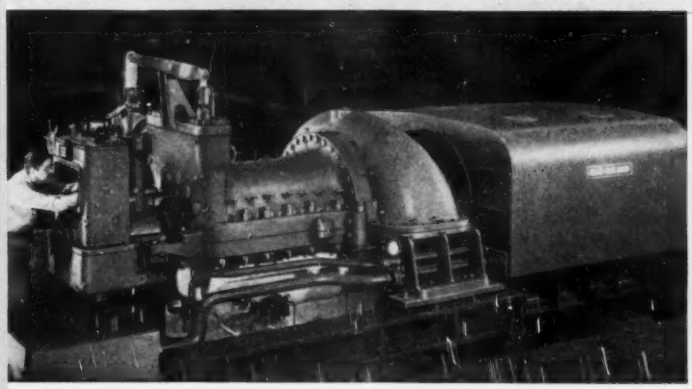


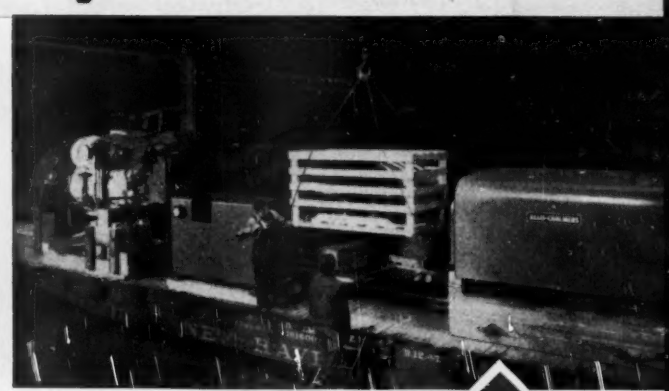


to Shipment!

3 Assembled 3-bearing unit — complete with housing type air cooled generator — ready for factory testing. **Both oil piping and generator air coolers are above the floor line.**

4 Entire WA-Series 3000-kw unit—pre-tested and insulated—being loaded on **one** flatcar for unit shipment. Both turbine and generator are shipped with their **rotors securely locked in place.**





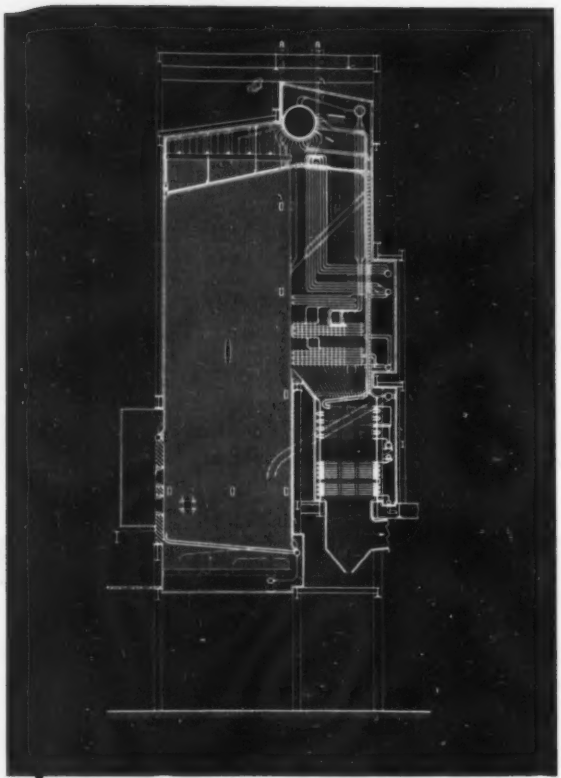
ALLIS-CHALMERS

World's Widest Range of Power Plant Equipment

A-C ALLIS-CHALMERS

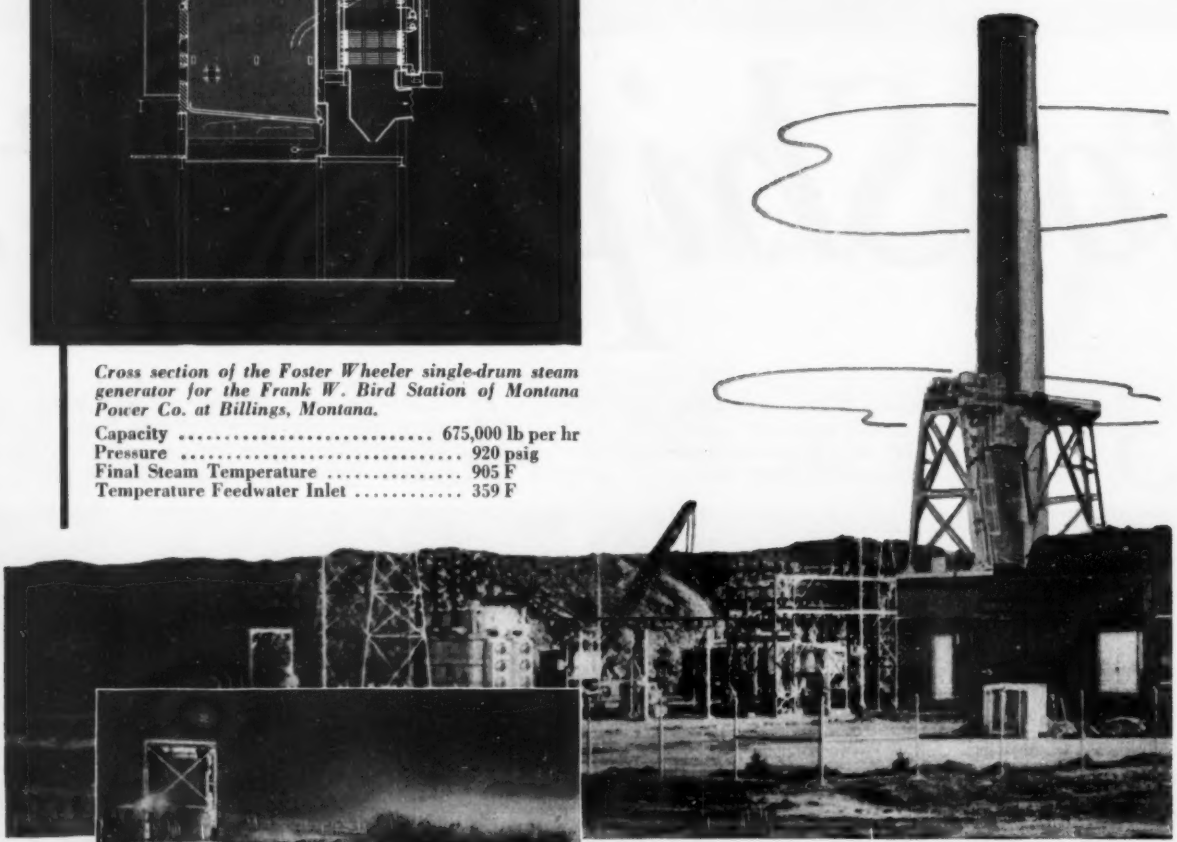
"Operation SUB-ZERO" Proves

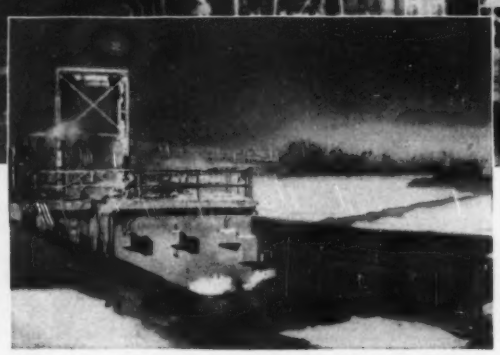
Bird Steam Plant shows 11,400 Btu per kwh station output for all purposes



Cross section of the Foster Wheeler single-drum steam generator for the Frank W. Bird Station of Montana Power Co. at Billings, Montana.

Capacity	675,000 lb per hr
Pressure	920 psig
Final Steam Temperature	905 F
Temperature Feedwater Inlet	359 F

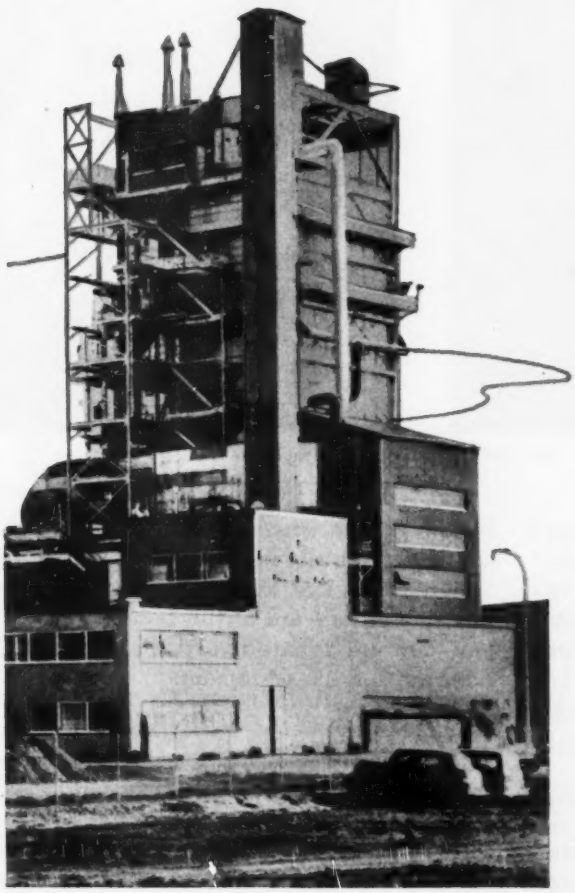




Circulating water intake showing severe conditions of winter operation.

Efficient and Economical

Under the severe operating conditions of temperatures as low as —40F at an elevation of 3100 feet, this semi-outdoor plant of the Montana Power Company engineered by Ebasco Services Inc., has proved efficient and economical in operation and construction. Here are the facts:



HIGH STATION EFFICIENCY

During October 1952, with a metered daily average kwh output of 65,917, the fuel burned for a day consisted of 1,464 bbl of oil, plus 7,630,536 cu ft of natural gas. The oil provided 6,400,000 Btu per bbl, the gas 1,140 Btu per cu ft. Total Btu for all purposes per kwh station output was 11,400.

OPERATED ABOVE RATED CAPACITY

Although normal load condition did not require regular operation above 600,000 lb steam per hour and 60 megawatts, load was picked up to 705,000 lb steam per hour and 76 megawatts in fifteen minutes and carried for two hours.

MINIMUM PERSONNEL

Efficiently operated by only 4 men on each 8-hour shift.

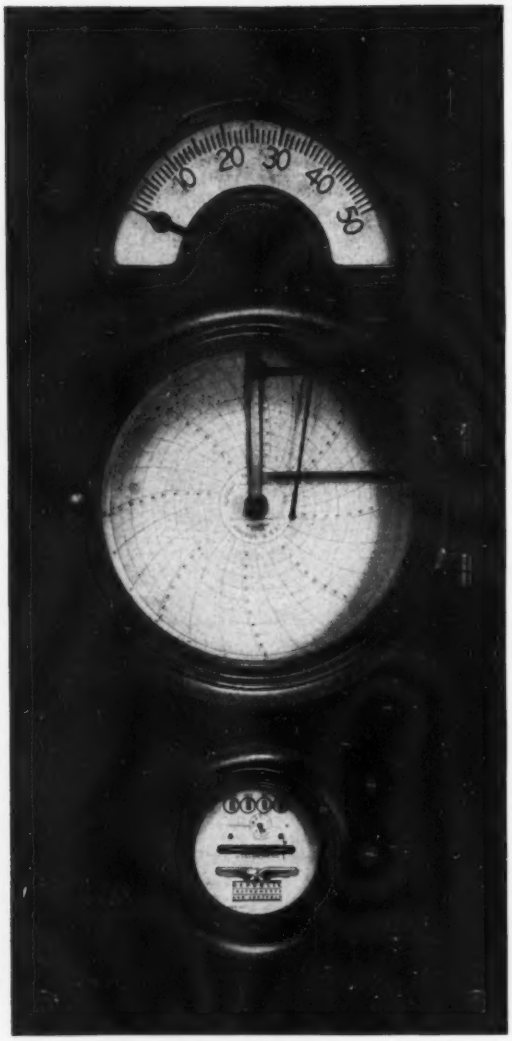
CONSTRUCTED COST

Complete cost, on the basis of 66,000 kw, was approximately $87 per kw.

Once again, the operating facts of an installation indicate the ability of Foster Wheeler to design and fabricate power-producing equipment to meet your needs.

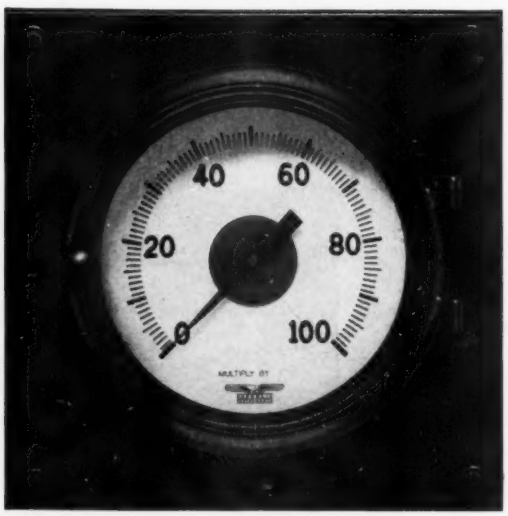
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER



Indicator-Recorder-Integrator

Varying flows because the



Indicator

The Republic flow integrator, being of the modified watt-hour type, totalizes continuously —not intermittently. It operates independently of the recorder and its accuracy is not dependent on or affected by any clock mechanism or mechanical action.

The Republic meter is, on this account, peculiarly fitted to follow all changes in flow rate and accurately measure highly fluctuating flows.

ALL TYPES OF FLUIDS

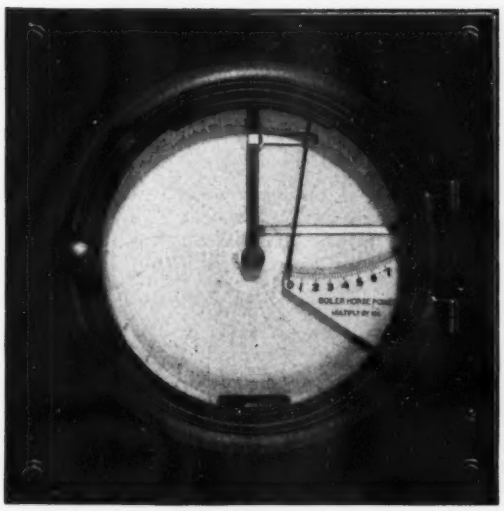
Republic electric type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 5,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator—are of the remote reading type and can be located any distance from the point of flow measurement.

ANY COMBINATION

While each Republic reading instrument is standard in design and construction each is especially calibrated for the particular flow measurement for which it is specified. Any reading instrument, indicator, recorder or integrator, may be obtained separately or in any

are accurately totalized

integrator is continuous



Recorder

Integrator

combination desired, making possible the highest degree of flexibility in plant use.

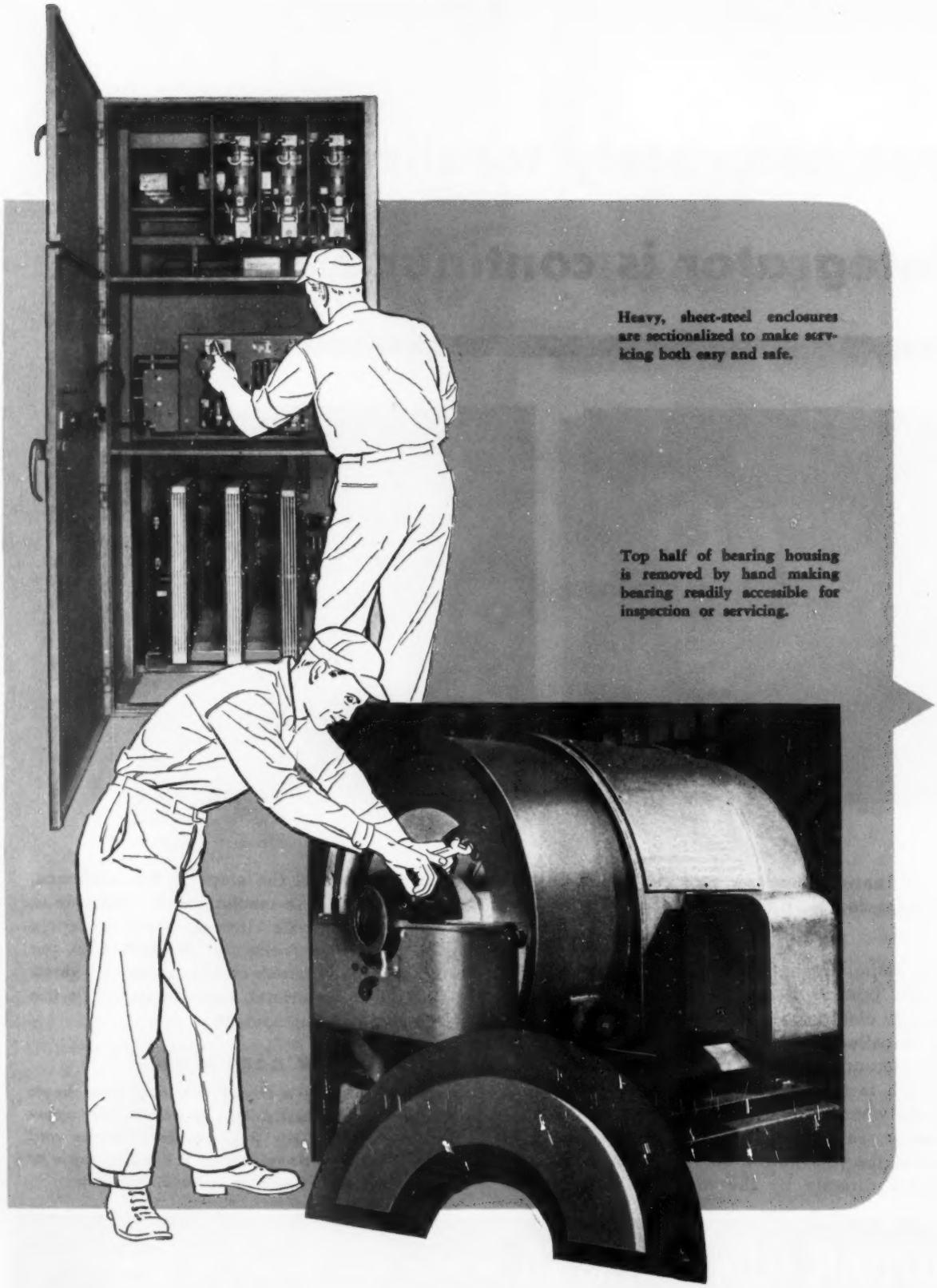
SIMPLE IN OPERATION

The Republic electric meter is the only flow meter commercially manufactured which is strictly electric in its operation. All other types of so called electric meters use the motion of the mercury to move a float or produce a force which is then converted into an electrical value which is in turn transmitted to a receiving or reading instrument. In the Republic meter, the transmitted electrical value is determined directly by the mercury motion, thus eliminating one of the steps in the sequence, and simplifying the mechanism to that extent. Their are no floats, levers, cams, rotating shafts or anything else to interfere with the unimpeded movement of the mercury, which has no work to perform, but merely fulfills the function of making contact.

NEW DATA BOOK

Just off the press—a completely new data book describing and illustrating, in detail, the operating features of the Republic Flow Meter and its many applications. Write for your copy of Data Book No. 702—there is no obligation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS



Heavy, sheet-steel enclosures are sectionalized to make servicing both easy and safe.

Top half of bearing housing is removed by hand making bearing readily accessible for inspection or servicing.

This matched pair reduces servicing time to minutes

Every servicing operation from checking bearings to replacing contacts takes a minimum of time—without the usual muss and fuss—on this motor and control team. All components are functional in design and easy-to-get-at. No special tools are required.

On Westinghouse Large Induction Motors you simply remove the top half of the bearing housing by hand and the bearing is accessible for inspection and servicing. No top bracket to remove—no crane to lift heavy, cumbersome parts. One man and a few minutes is all that it takes.

One man can remove the motor's light, sturdy sectional covers and air shields by hand also. Here again, no crane is required—complete operation can be performed in a matter of minutes.

An occasional look in the door meets most of the servicing requirements on this Westinghouse High-Voltage Starter with air-break contactor. Simple, dependable design assures long mechanical life of the contactor and its moving parts.

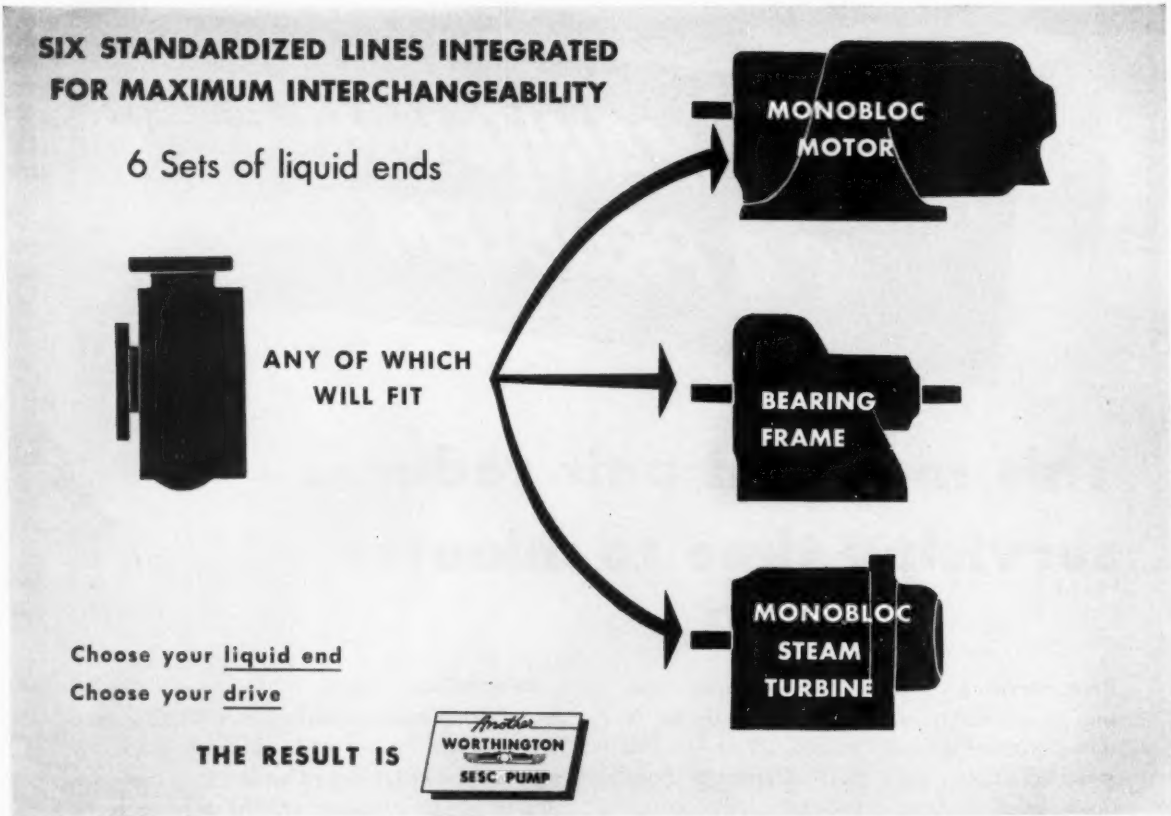
Powerful magnetic blowouts and large arc boxes effectively confine arcs—increase contact life. Built-in fuses are readily accessible . . . easy to install or replace.

Westinghouse Large Induction Motors and High-Voltage Starters are the perfect power partners. Get the benefits of their co-ordinated operation. Call your local Westinghouse representative now for complete details. Or, if you prefer, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10357-A

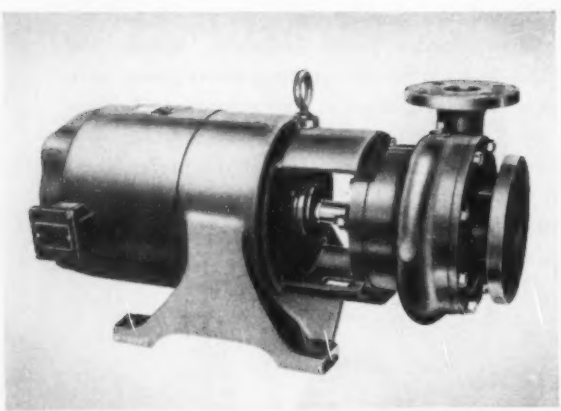
YOU CAN BE SURE...IF IT'S

Westinghouse

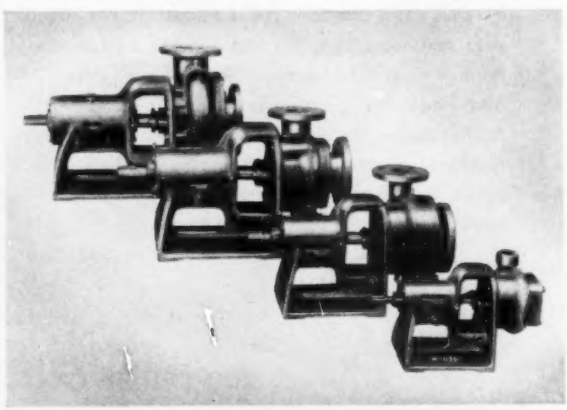
How Worthington makes



WORTHINGTON STANDARDIZATION assures you the one *right* pump for every job. Most "specials" can be assembled from standard parts and shipped to you without delay.



THE WORTHINGTON MONOBLOC, the pump with a built-in motor, has long been famous for its compact, streamlined design. It handles many different jobs because it uses any of the six liquid ends that are interchangeable and can be equipped with either conventional packing or mechanical seal.



FRAME-MOUNTED PUMPS use the same rugged mounting as the monobloc units and the six liquid ends fit in four frame sizes. Like the monoblocs, they use a standardized mechanical seal that can easily be changed in the field if necessary. They'll take any kind of drive readily available.

standard pumps do special jobs

Worthington's SESC* line provides for "custom" assembly from standardized parts with standardized mountings, materials and dimensions to give you exactly the centrifugal pump you need

When you order a Worthington centrifugal pump you get the one *right* pump for the job without compromise, without long delays and without paying a premium for a pump to meet "special" requirements.

Worthington can assure you this, because Worthington can assemble any of 60,000 *different* standard pumps, covering virtually every possible application, from 650 standardized parts. Nearly all *special* pumping needs can be filled with a Worthington *standard.*

Worthington SESC centrifugal pumps are husky and well-built—not flimsy, light-duty units. In fact, users find them of better construction than is usually available in custom jobs at higher prices.

To sum up, you can expect the following advantages when you buy Worthington centrifugal pumps:

- **Greater availability,** since Worthington is equipped to handle more requirements with a *standard* unit.
- **Broader selection** of ratings and special design features.
- **Easier servicing** with lower parts-inventory requirements.

Contact your local Worthington distributor or nearest Worthington district office. Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

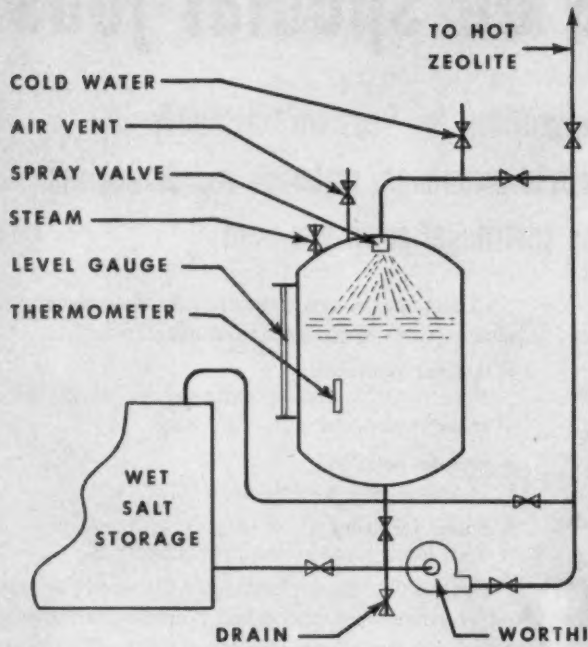
*SESC—Standardized End Suction Centrifugal C.2.14

MANY YEARS OF DEVELOPMENT WORK coupled with Worthington's 112-year pumping experience has led to the development of the present Worthington line of centrifugal pumps. This is a view of a section of Worthington's Engineering Department which includes specialists in virtually every field of industry. C.2.14

The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Centrifugal Pumps



SEQUENCE OF OPERATION OF WORTHINGTON'S HOT-Z REGENERATING SYSTEM*

1. To initiate service, gradually raise zeolite to operating temperature by regulating steam supply to injection water.
2. Return excess water to wet salt storage or discharge through drain.
3. Fill heater storage with saturated brine to desired level.
4. Recirculate until operating temperature is reached.
5. Deliver measured, heated and deaerated brine to zeolite.
6. Return excess brine to wet storage for resaturation.
7. To cut zeolite out of service, inject fully heated water and gradually reduce temperature by regulating steam supply.

*patent applied for.

MAXIMUM LIFE FROM ZEOLITE

How Worthington's Hot-Z Plant protects Zeolite by maintaining uniform temperature during regeneration

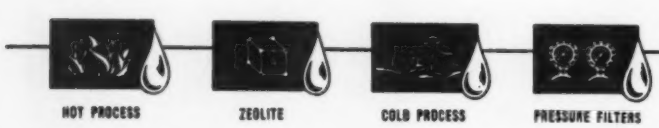
Another feature to check into when you're choosing Hot-Z treating equipment: *the regenerating system.*

For maximum life of the zeolite, two requirements should be met. 1. *A uniform temperature* should be maintained while regenerating the zeolite: that is, the regenerant solution should be held at essentially the same temperature as the water under treatment. 2. When putting a softener into or out of service, the temperature of the zeolite should be raised or lowered *gradually.*

Worthington has accomplished this dual objective with a brine deaerating heater for regenerating the hot zeolite. Its operation is explained in the diagram and accompanying caption. Deaeration is desirable to retard corrosion which might be caused by oxygen in the brine.

This heating system is just one of several exclusive features you'll find in every Worthington Hot-Z system. Remember, too, that Worthington makes all of the major types of water conditioning systems. Let us study your problem and recommend the most suitable solution. Write, stating service conditions in detail, to Worthington Corporation, Water Treating Division, Harrison, N. J.

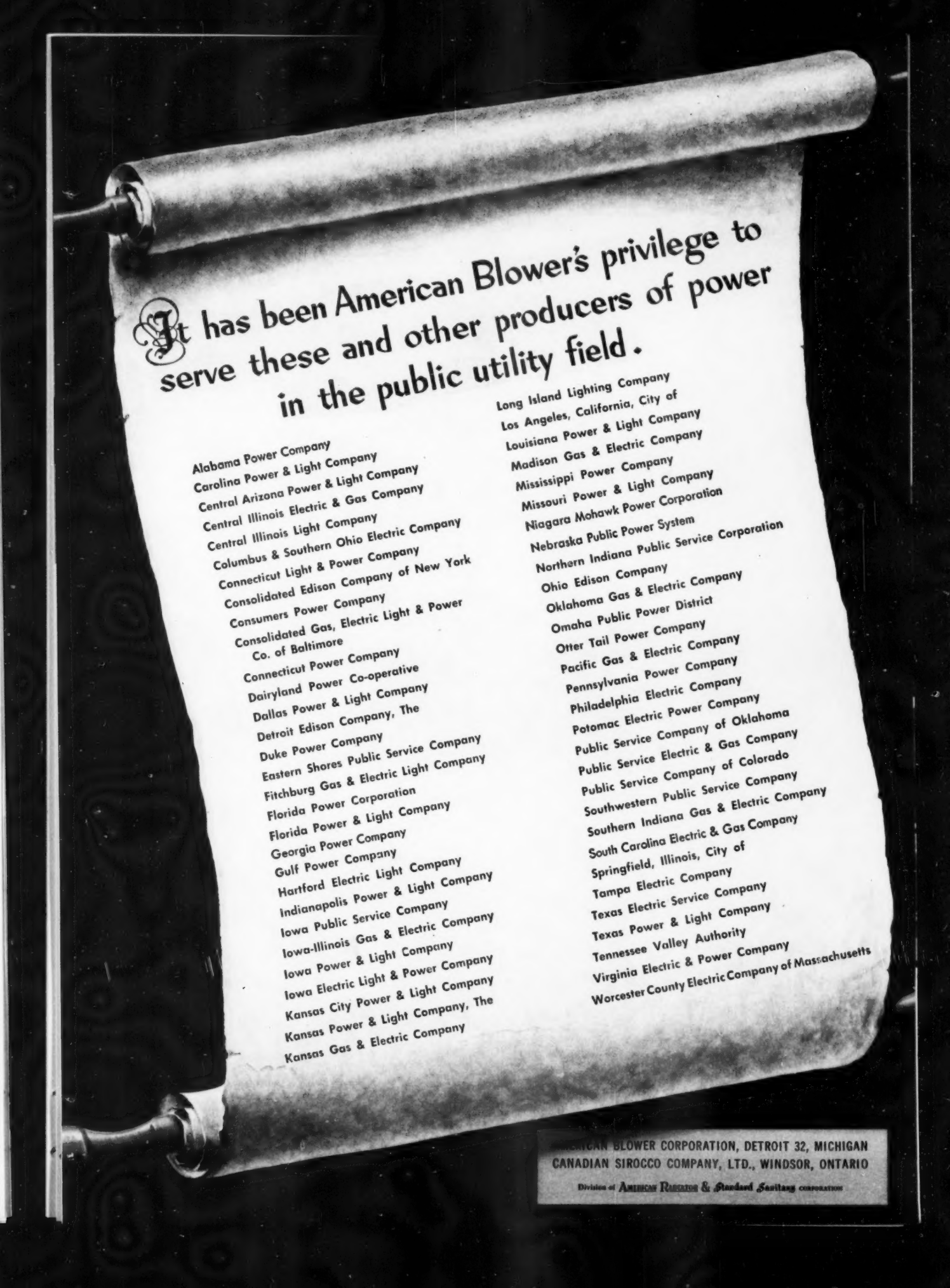
J.2.3



Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning


It has been American Blower's privilege to serve these and other producers of power in the public utility field.
Alabama Power Company
Carolina Power & Light Company
Central Arizona Power & Light Company
Central Illinois Electric & Gas Company
Central Illinois Light Company
Columbus & Southern Ohio Electric Company
Connecticut Light & Power Company
Consolidated Edison Company of New York
Consumers Power Company
Consolidated Gas, Electric Light & Power Co. of Baltimore
Connecticut Power Company
Dairyland Power Co-operative
Dallas Power & Light Company
Detroit Edison Company, The
Duke Power Company
Eastern Shores Public Service Company
Fitchburg Gas & Electric Light Company
Florida Power Corporation
Florida Power & Light Company
Georgia Power Company
Gulf Power Company
Hartford Electric Light Company
Indianapolis Power & Light Company
Iowa Public Service Company
Iowa-Illinois Gas & Electric Company
Iowa Power & Light Company
Iowa Electric Light & Power Company
Kansas City Power & Light Company
Kansas Power & Light Company, The
Kansas Gas & Electric Company
Long Island Lighting Company
Los Angeles, California, City of
Louisiana Power & Light Company
Madison Gas & Electric Company
Mississippi Power Company
Missouri Power & Light Company
Niagara Mohawk Power Corporation
Nebraska Public Power System
Northern Indiana Public Service Corporation
Ohio Edison Company
Oklahoma Gas & Electric Company
Omaha Public Power District
Otter Tail Power Company
Pacific Gas & Electric Company
Pennsylvania Power Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Public Service Company of Colorado
Southwestern Public Service Company
Southern Indiana Gas & Electric Company
South Carolina Electric & Gas Company
Springfield, Illinois, City of
Tampa Electric Company
Texas Electric Service Company
Texas Power & Light Company
Tennessee Valley Authority
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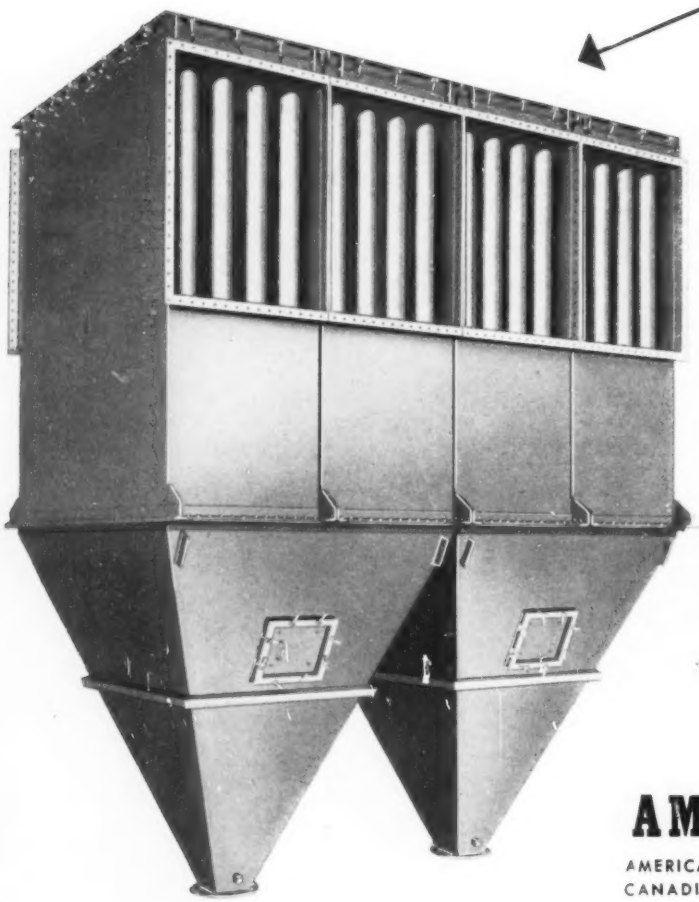
This filter
collects the sludge
from the oil in your car



This American Blower
Fly Ash Precipitator
collects fly ash from boilers
in power plants burning
solid fuels.

In both instances,
objectionable material
is collected in a
proved, practical manner.
Investigate American Blower
Fly Ash Precipitators NOW!

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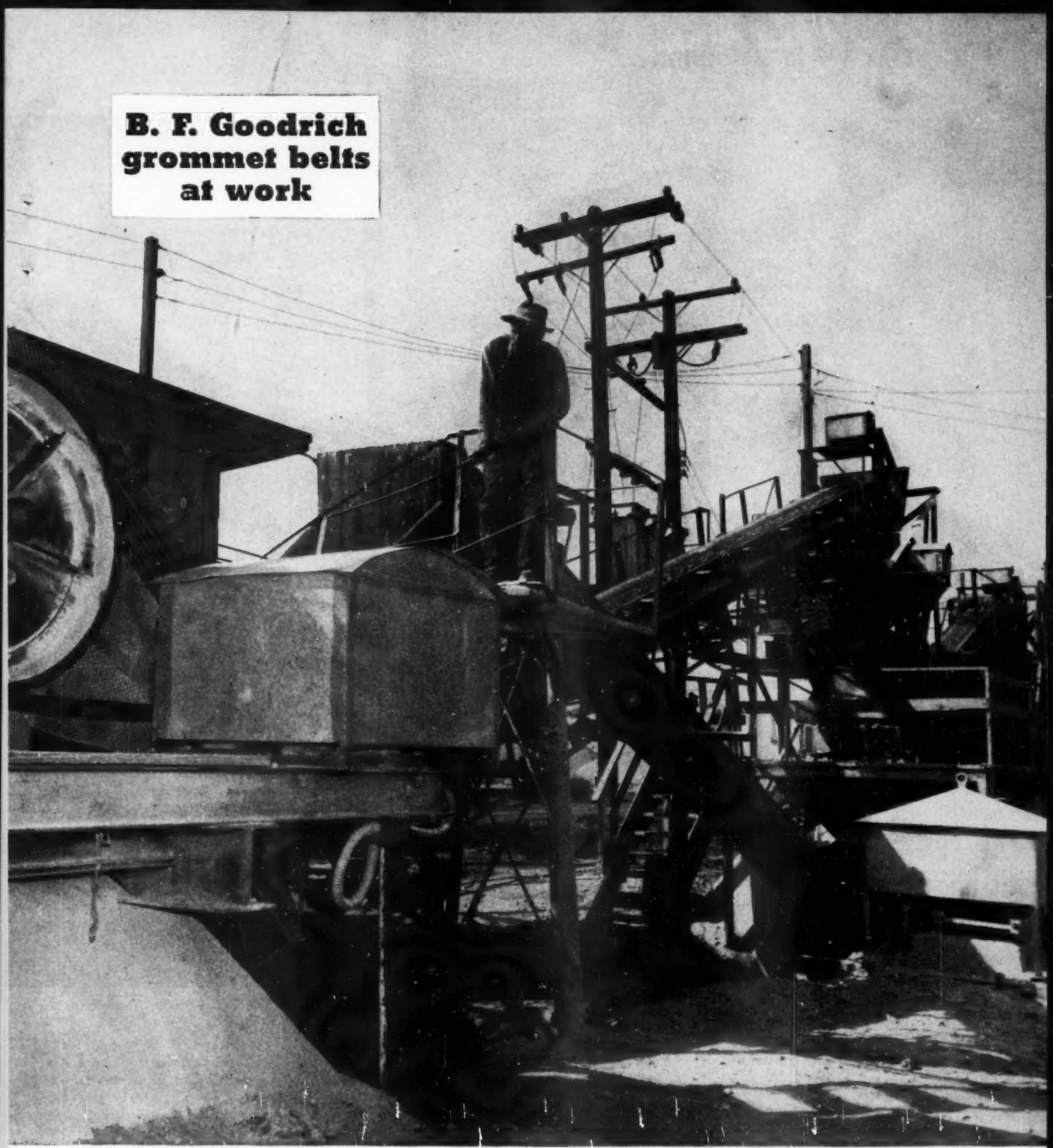
Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS & WALL TILE · DETROIT CONTROLS · KEWANEE BOILERS · ROSS EXCHANGERS

B. F. Goodrich grommet belts at work



When it reaches the end of that roller coaster, a rock has become gravel as each climb carries it to another crusher.

Iron jaws chew rocks

Crushing big rocks not only jolts the crusher, but also puts terrific shock loads on the V belts that drive it. And if the belts can't take the shock treatment—if the drive stops because of premature belt failure—the whole operation shuts down, deliveries are delayed. Obviously, an exceptional kind of V belt was needed to solve this problem—as you'll see on the following pages.

Iron jaws (continued)

They work double and triple shifts at this California company—so they figure the grommet V belts gave 9 years' service in 4.

The danger of frequent belt failures described on the preceding page was solved when B. F. Goodrich grommet V-belts were installed, and gave four years of trouble-free service. This record is even more spectacular when you consider that in addition to the jolting strain of running the primary crusher, these grommet belts had no protection from the hot sun or the abrasive action of sand and grit. Here's why grommet belts last longer, serve better, save money.

20 to 50% Longer Life

Grommet V belts, made only by B. F. Goodrich, represent the only basic improvement since invention of the V

belt. Belts last 20 to 50% longer, depending on the service. (The more severe the service the greater the increase over ordinary belts.)

What is a grommet?

A grommet is like a giant cable except that it's endless—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All Cords Put to Work

In ordinary belts under high tension the center cords "dish" and tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Each grommet and every part of a grommet carries its share of the load. Grommet V belts have no center cords—therefore much more strength in proportion to cord volume.

Better Grip, Less Slip

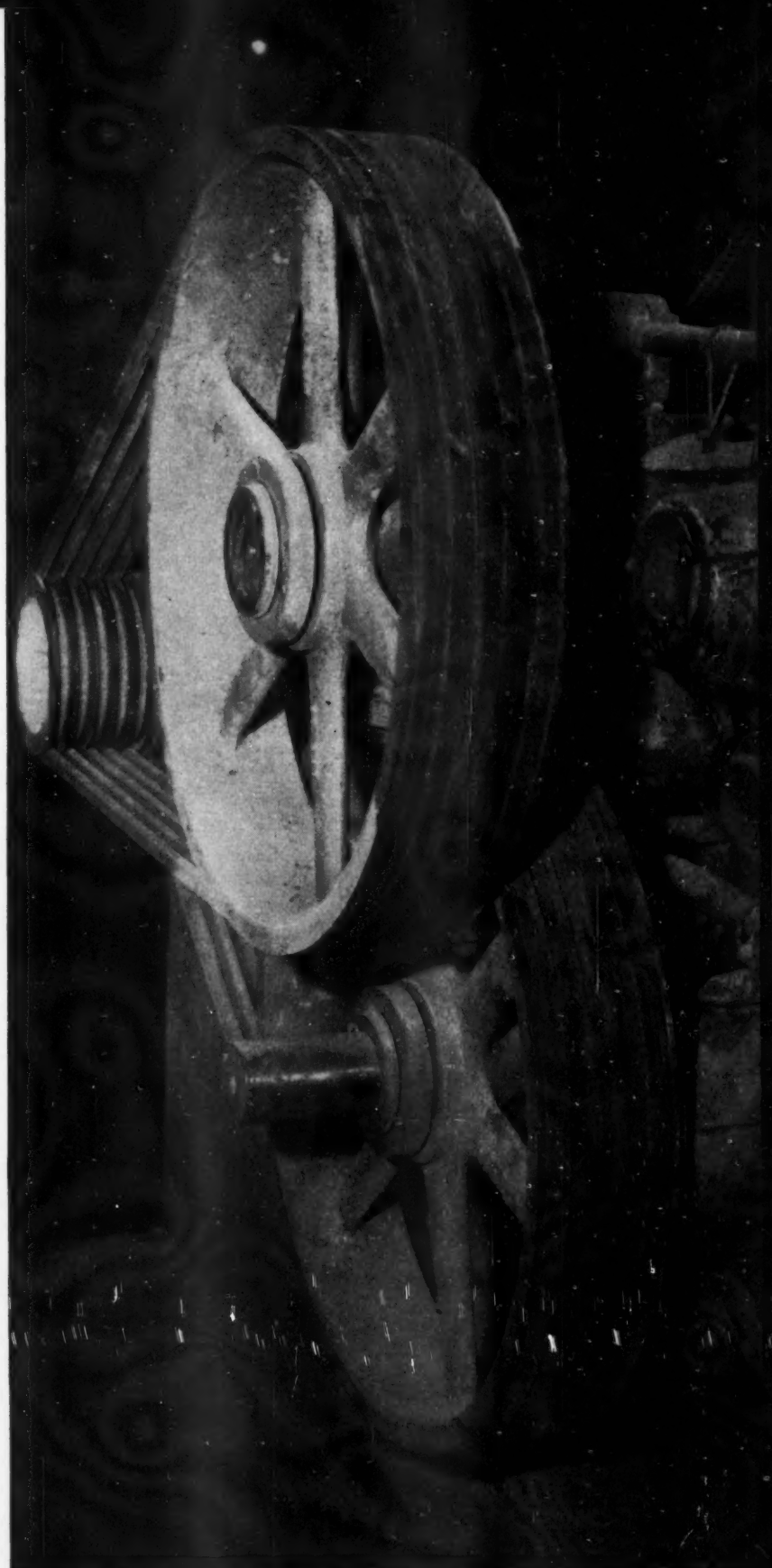
Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip there is also less surface wear.

They Cost No More

You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D, and E sections. Only B. F. Goodrich makes the grommet V belt.

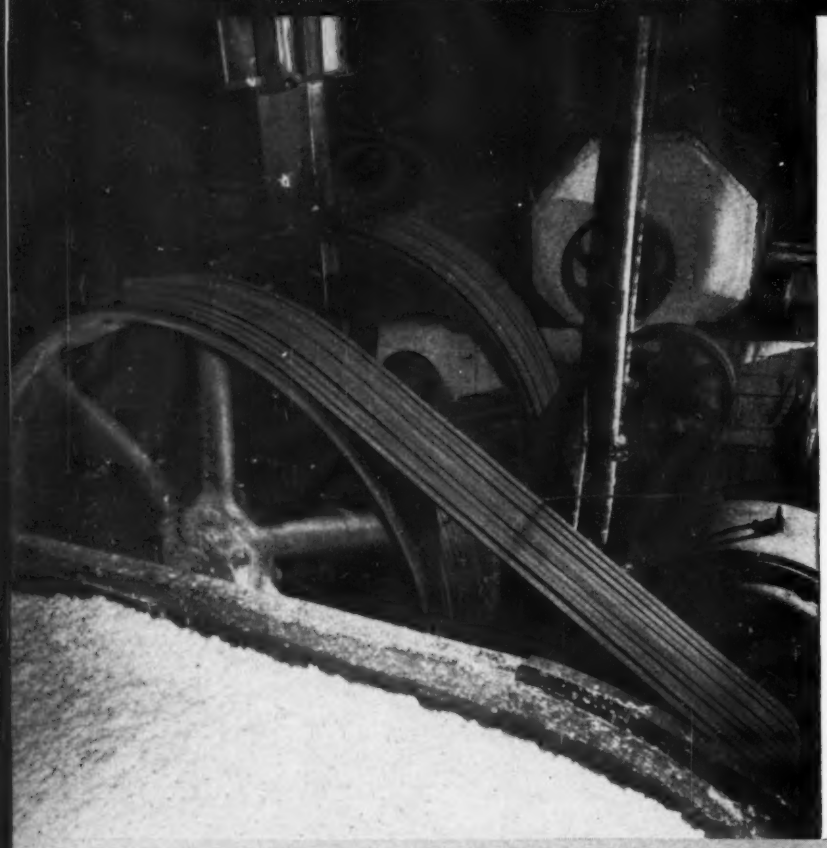
Cracking good

Soy beans are cracked in a roller mill driven by these V belts. You'll notice there's a man missing in the picture. He's the maintenance man who used to spend a lot of time here, repairing or replacing the belts previously used. Since B. F. Goodrich grommet belts were installed, he's not needed any more. The grommet belts, which have been on the drive for over a year now, have eliminated downtime, cut costs 50%.



Grommet V belts run night and day, seven days a week in this mill.

B. F. Goodrich grommet belts at work



Stationery movement

Beating old rags to pulp is one of the first steps in making fine stationery. Expensive leather belts used to drive this pulp beater. But it's rough service. Starting the beater causes shock loads, and the 24-hour-a-day service would be a strain on any driving mechanism. The leather belts stretched, then slipped, broke down too often. The paper company wanted reliability—and got it—when B. F. Goodrich grommet V belts were installed. In spite of shock loads and continuous operation, the original set of grommet V belts has already given two trouble-free years of service, eliminated the problem of slippage, saved 25% on production costs.

Belts take a beating, give a beating to pulp at The Strathmore Paper Co., West Springfield, Mass.

These typical examples (see preceding pages) tell you why B. F. Goodrich grommet belts are superior to ordinary V belts—prove they last 20 to 50% longer—yet cost no more.

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

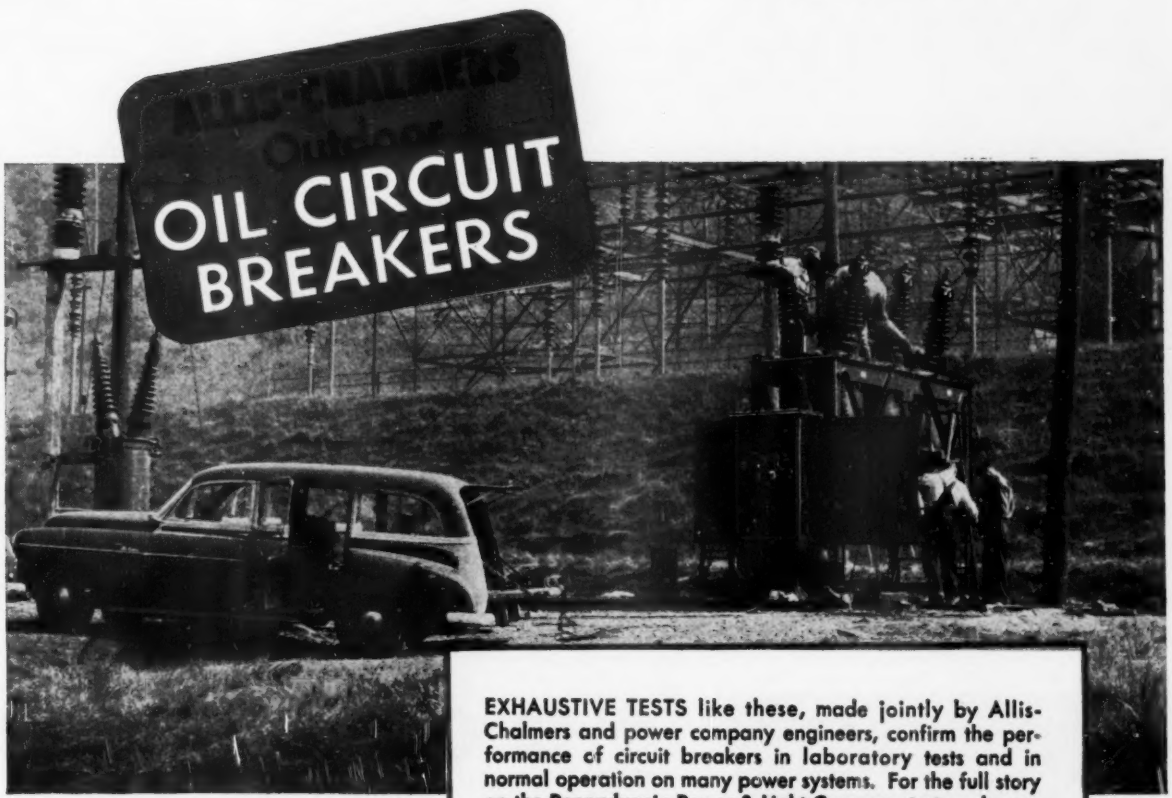
The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio

HOW MUCH Can a Breaker Take?

Here's the Answer Provided by Field Tests on Pennsylvania Power & Light Company System

In a single test series, a standard Allis-Chalmers 69-kv breaker provided Pennsylvania Power & Light Company engineers with positive proof of its ability to:

1. Interrupt a total kva power of approximately *18 times* its interrupting rating — *with no maintenance or adjustment* during the test period.
2. Include, in the total, *eleven* fault interruptions at or above full breaker rating.
3. Pass a group of line-charging and discharging tests *without a restrike.*
4. Show, on inspection after test, that more service could safely be expected.



Standard production-line FZO-151-69F breaker was used for these field tests.

EXHAUSTIVE TESTS like these, made jointly by Allis-Chalmers and power company engineers, confirm the performance of circuit breakers in laboratory tests and in normal operation on many power systems. For the full story on the Pennsylvania Power & Light Company tests, ask your A-C representative for Bulletin 71R7855, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3791

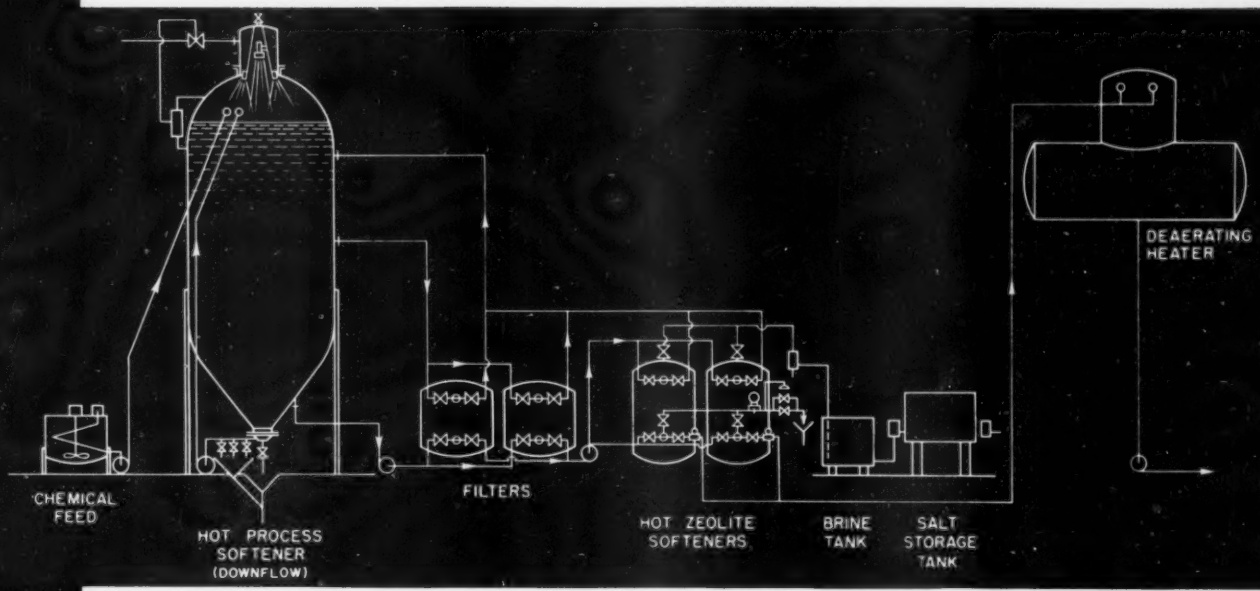
ALLIS-CHALMERS

"We need an unbiased water conditioning recommendation. Let's get a proposal from

cochrane

Whether your water conditioning problem is simple or complex, call on Cochrane. Our *full range* of water conditioning equipment assures you *unbiased recommendations* and freedom from makeshift methods.

Cochrane recommendations are based on 90 years of specialized experience in water treatment. And those recommendations are without bias or prejudice—because Cochrane designs and builds *every kind and type* of industrial water treating equipment."—From Cochrane you get the plan and the products to give you water of the quantity and quality you want—with greatest economy. Before you decide on any water conditioning system, be sure to consult Cochrane water engineers.



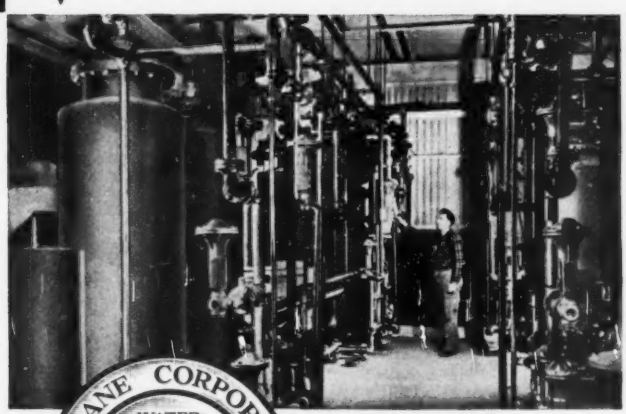
COCHRANE HOT PROCESS ZEOLITE SOFTENER COMBINES EFFICIENCY AND ECONOMY

Combination of a versatile Cochrane Hot Process Softener and a Zeolite second stage provides all the advantages of both systems. It is the most effective and economical means of reducing silica in boiler feedwater preparation. Low total Methyl Orange alkalinities are readily obtained, resulting in lower carbon dioxide in steam generated from this water.

Additional economies and benefits are chemical cost savings obtainable and simplicity of operation. Reason: Inexpensive salt is used for hardness removal instead of more costly soda ash and phosphate. Also, the hardness of the process effluent entering Zeolite units is usually quite low, permitting long Zeolite runs and infrequent regeneration.

LOW COST SOLUTION TO MINERAL SOLIDS PROBLEMS

For economical production of water that is comparable to commercially distilled water in low mineral solids, Cochrane demineralizers are available in multi-bed or mixed bed units of both manual or automatic design for any required capacity. Cochrane demineralizers embody sound design, superior workmanship and conservative ratings to assure maximum operating efficiency and longest life.



Cochrane Automatic Demineralizer producing water of less than 1.0 ppm total dissolved solids in large midwest plant.

COCHRANE CORPORATION
WATER ENGINEERS FOR 90 YEARS
1863 - 1953

Cochrane equipment covers the full range of water conditioning:

HOT PROCESS SOFTENERS
HOT AND COLD ZEOLITE SOFTENERS
DEAERATORS & OPEN HEATERS
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To give you prompt consultation and service, Cochrane Water Engineers are strategically located in 29 cities throughout the United States. Write for the address of our office nearest you.

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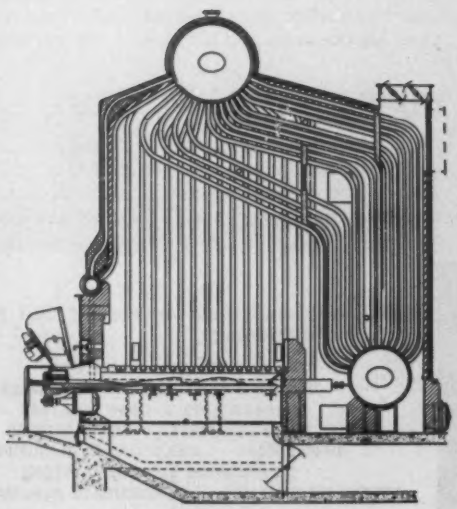
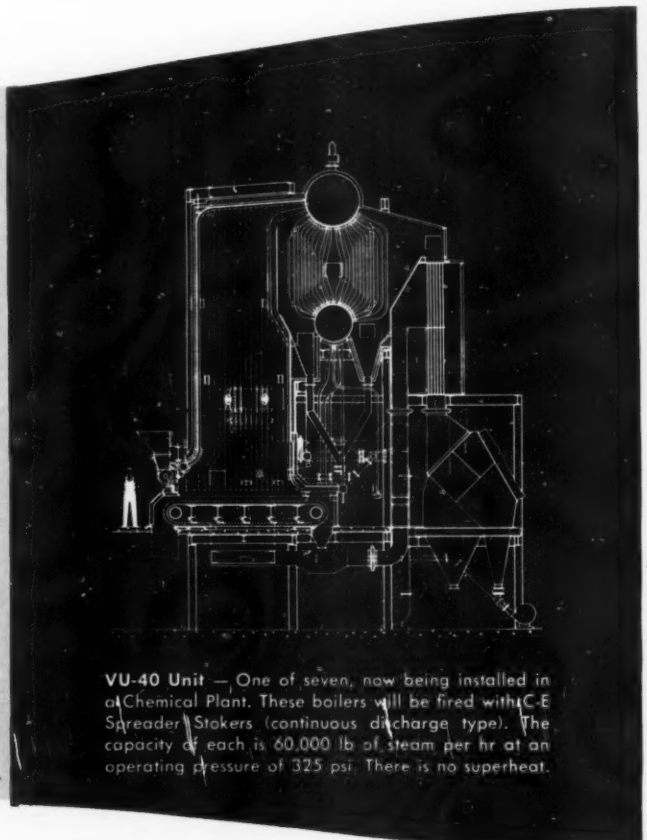
VU Utility Standards

Electric utility companies maintain the highest equipment standards in the power generation field. Kilowatts are their business — their product . . . to be turned out reliably, efficiently and at the lowest possible cost. To assure this they demand — and get — the most reliable — the most efficient — the best built boilers that the market affords.

To meet their highly critical standards the utilities have long been accustomed to purchase steam generating units that were, in large measure, individually designed to meet their particular needs.



VU-10 Boiler — This unit is installed in a hosiery mill. It is fired by a Type E Underfeed Stoker. Capacity — 12,500 lb steam per hr; operating pressure — 100 psi; no superheat. VU-10 Boilers are available in sizes from 10,000 to 60,000 lb of steam per hr.



VU-40 Unit — One of seven, now being installed in a Chemical Plant. These boilers will be fired with C-E Spreader Stokers (continuous discharge type). The capacity of each is 60,000 lb of steam per hr at an operating pressure of 325 psi. There is no superheat.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

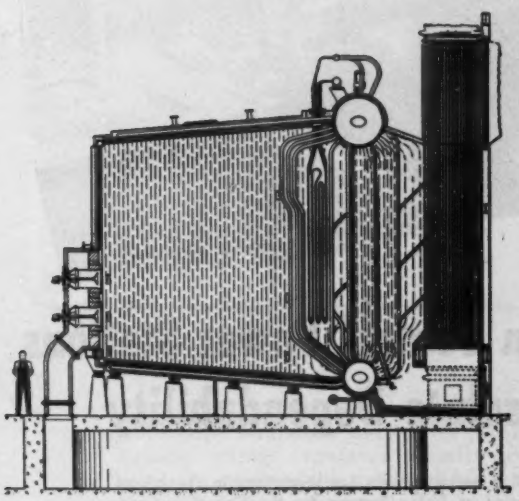
in a Standard Boiler

And C-E Vertical-Unit Boilers, particularly in the larger sizes, are available in "custom-made" designs to suit specific requirements. In fact, VU Units have been a popular choice with utility companies for many years.

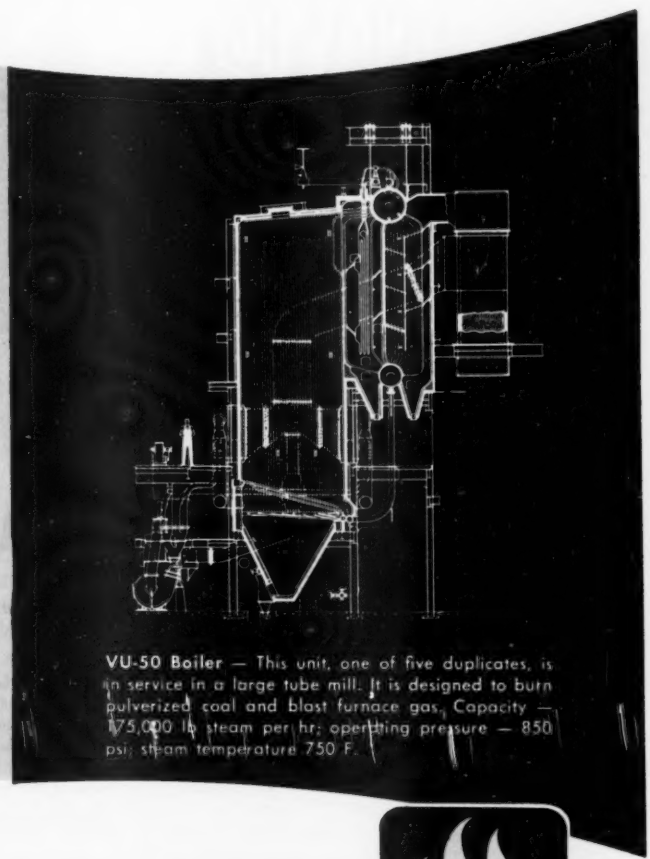
But many other designs that comprise the "VU family" are completely *standardized* . . . standardized without sacrifice of "custom-made" advantages. And when you standardize you reduce engineering costs, reduce manufacturing costs, reduce erection costs — in short, you save money.

Here then is a line of custom-quality boilers with all the benefits of standardization built in capacities from 10,000 lb of steam per hr up, for any pressure and temperature . . . and suitable for any type of fuel burning equipment.

Little wonder that industry — all industry — has found within the VU family a boiler unit exactly suited to its needs. Breweries and hosiery mills, chemical companies and steel plants — all have installed VU Boilers again and again with complete satisfaction. So can you.



VU-50 Boiler — This unit is one of two duplicates installed in a brewery. They are fired with oil or gas. Capacity — 100,000 lb of steam per hr; operating pressure 550 psi; steam temperature 700 F. This particular design is of the bottom-supported type.

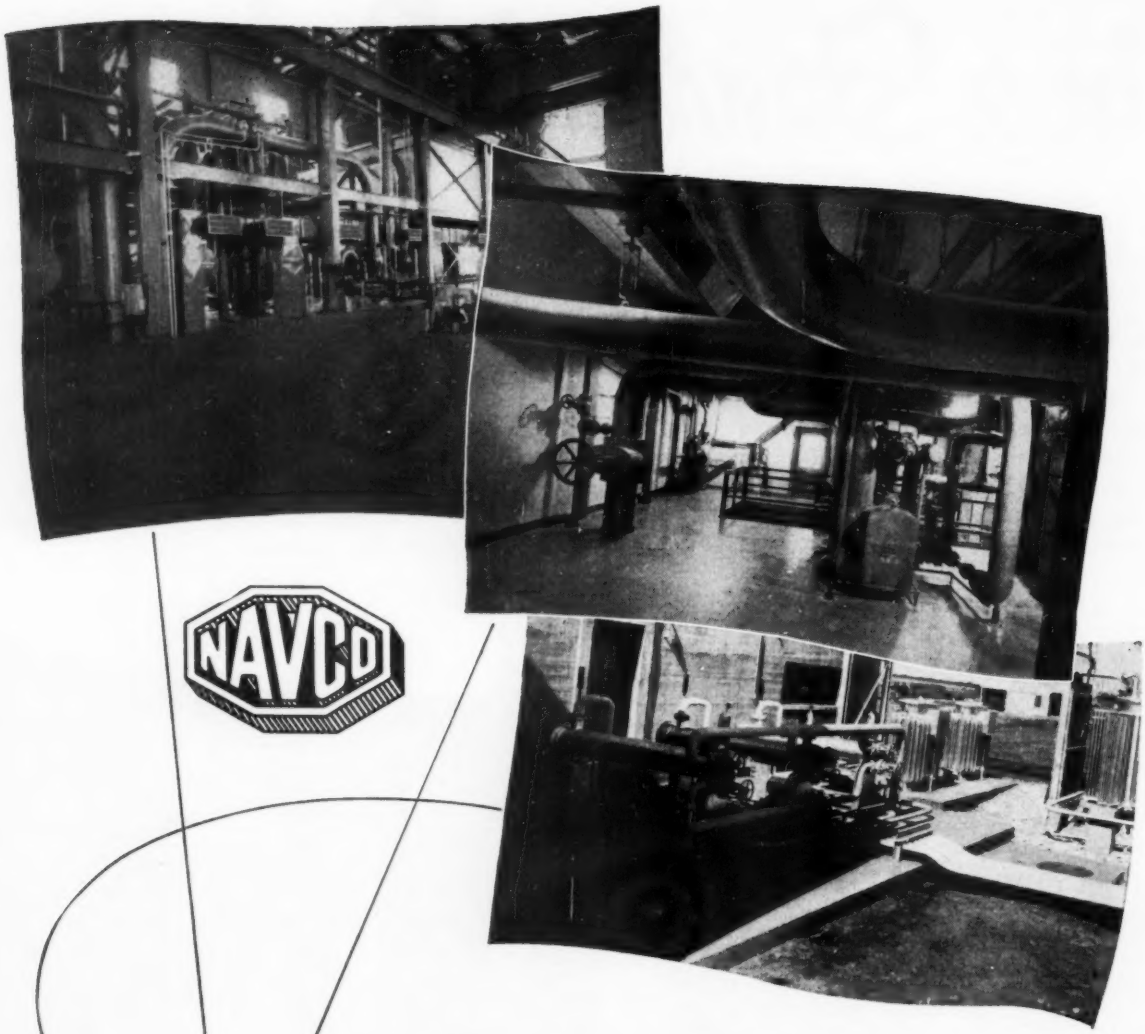


VU-50 Boiler — This unit, one of five duplicates, is in service in a large tube mill. It is designed to burn pulverized coal and blast furnace gas. Capacity — 175,000 lb steam per hr; operating pressure — 850 psi; steam temperature 750 F.

—SUPERHEATER, INC.

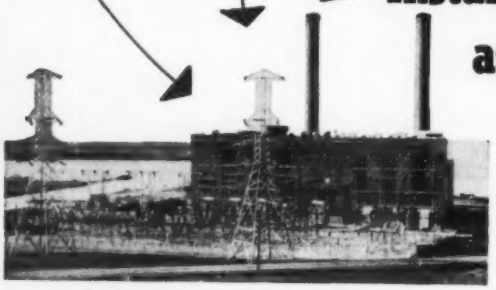
Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

8-649



NAVCO

Installations in Central Power Stations assure Absolute Dependability



FOR almost half a century Navco has specialized in the fabrication and erection of Piping Systems for the highest operating conditions.

The "first" base load Central Station Piping System operating at 1350 lbs. and 900° (back in '30)—the "first" carbon moly to be used in a complete Steam System of Central Station Piping—one of the "first" field x-rayed systems of Steam Piping and one of the "first" Piping jobs to serve a 1,000,000 lb. per hour boiler are among some of the many Navco installations.

Consult Navco for your next Piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA

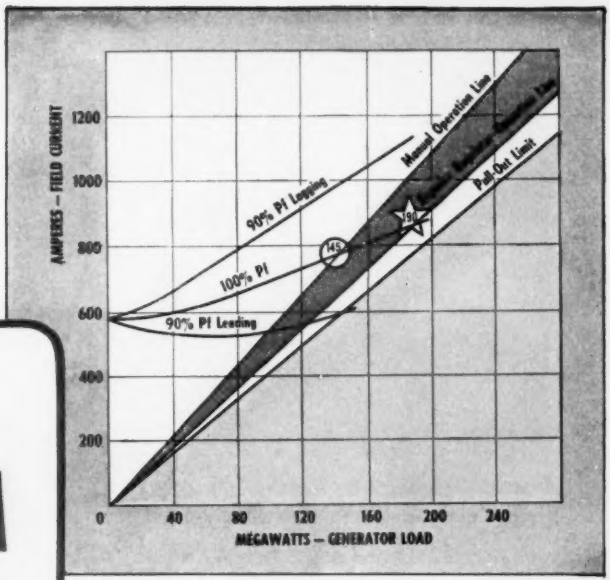
NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI

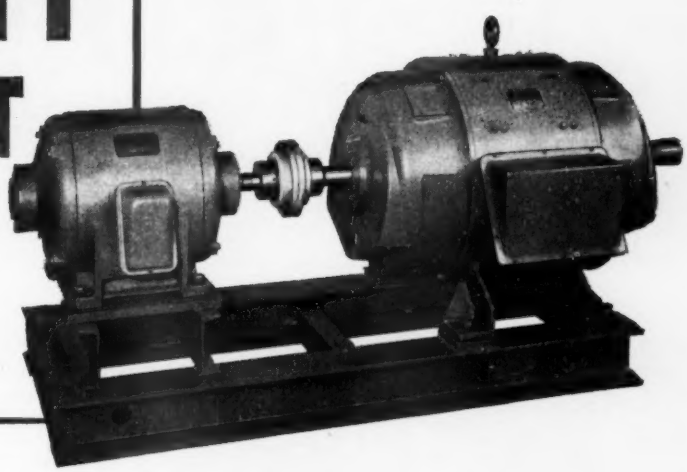
ALLIS-CHALMERS

Voltage Regulator

AFFORDS MAXIMUM KILOWATT OUTPUT

. . . at ANY Power Factor Loading





Automatic minimum excitation provided by *Regulex* voltage regulator permits generator operation closer to the stability limit . . . much closer than manual operation permits. Thus, maximum generator pay load is assured at any power factor loading.

The Graph Tells The Story

By providing maximum stability, *Regulex* voltage regulation establishes and maintains a *safe* ratio between generator load and field current. In the graph, the gray area represents the increase in safe operating limit. The starred figure on the *Regulex* regulator operation line and the circled figure on the manual line afford a comparison of megawatt output. Note that regardless of the power factor loading, a much greater generator pay load is provided by *Regulex* regulator automatic minimum excitation.

Profit in increased kilowatt output . . . meet new demands on old generators . . . get maximum productivity out of new generator installation . . . with the *Regulex* voltage regulator. For complete information, call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3924

Regulex is an Allis-Chalmers trademark.

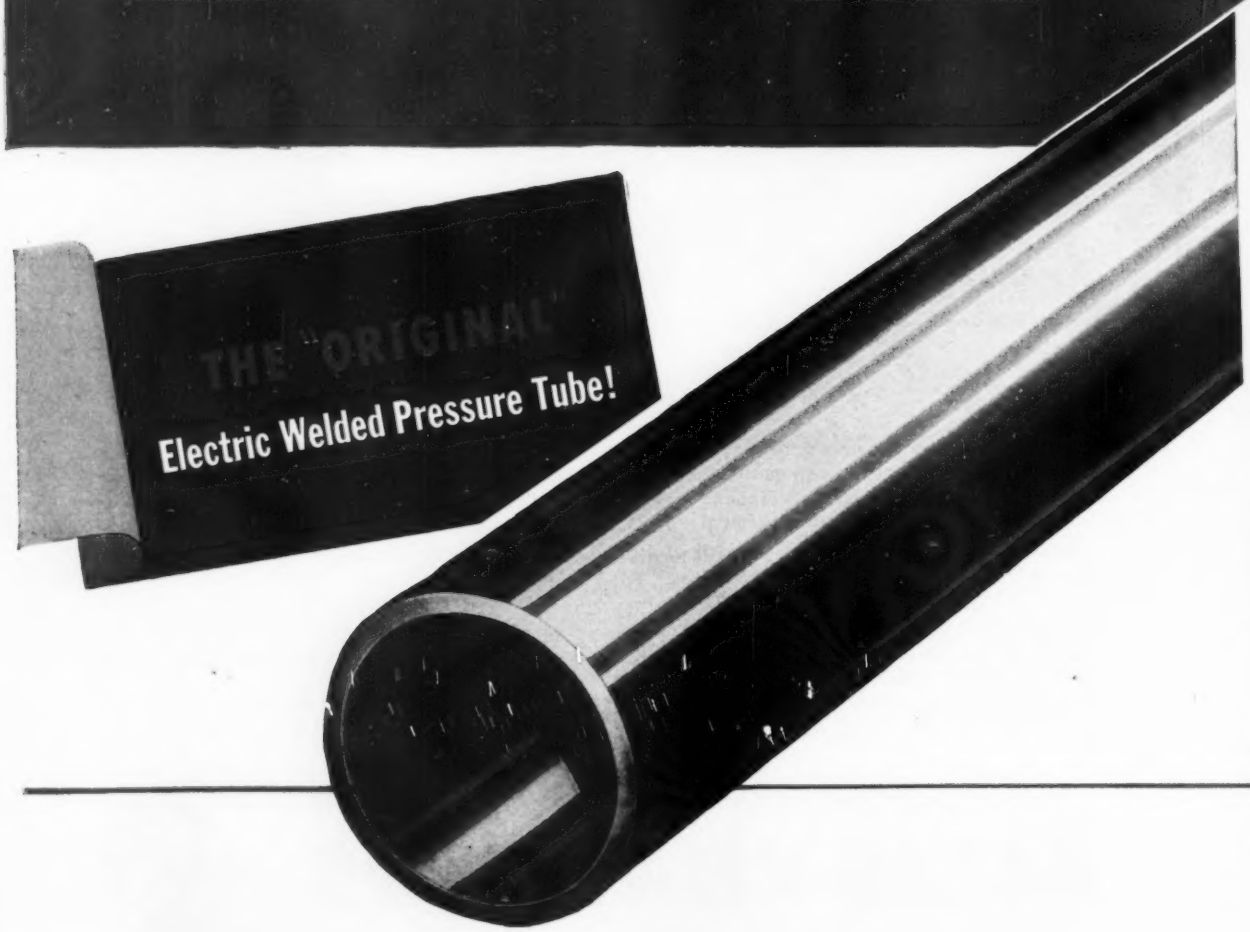
ALLIS-CHALMERS

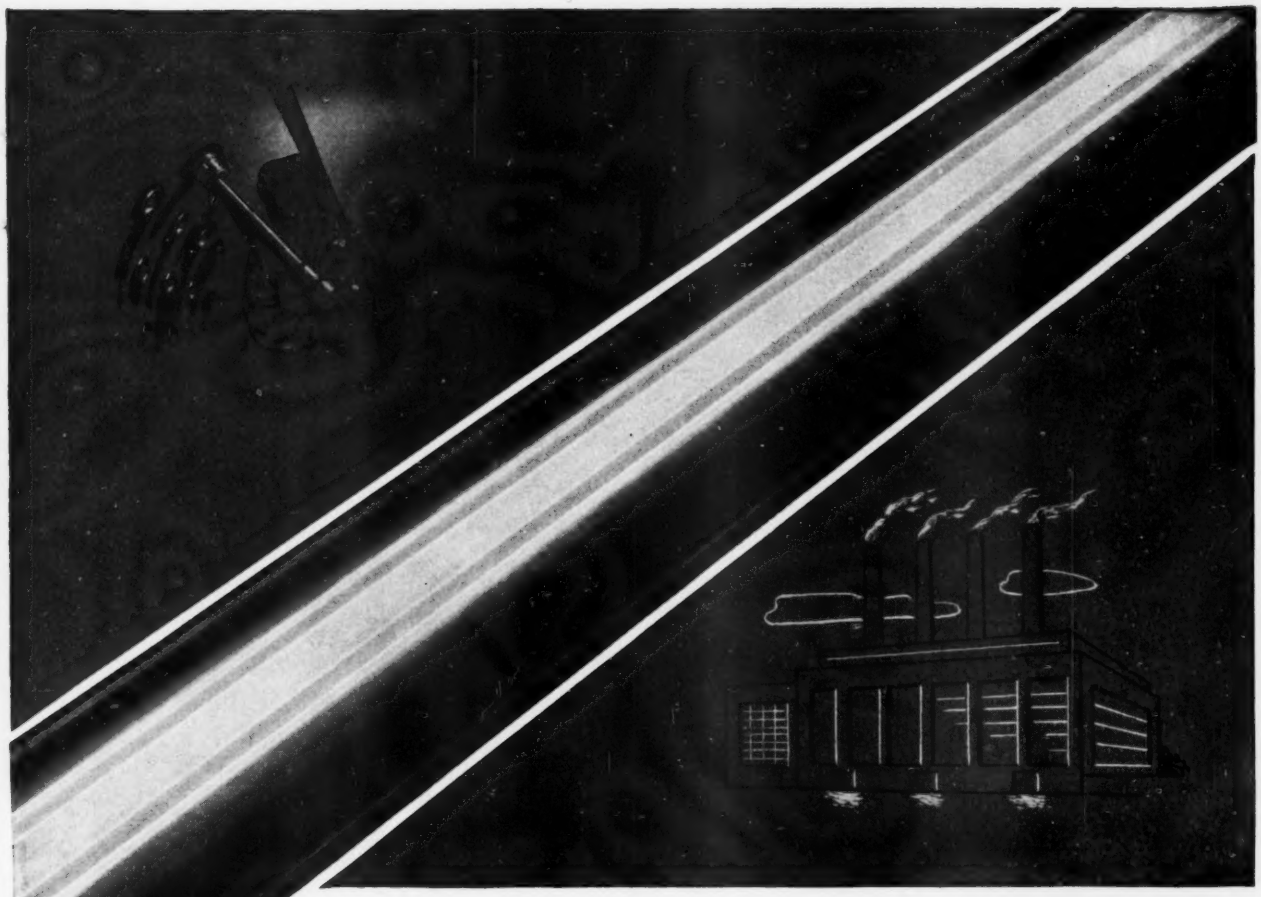
A-C ALLIS-CHALMERS

ELECTRUNITE

means

ELECTRICALLY UNITED





Derived from a combination of two words, *ELECTRically UNITEd,* ELECTRUNITE is the name applied to Republic's complete line of boiler, heat exchanger and condenser tubes, and to the *improved* process of electric resistance welding by which they are made.

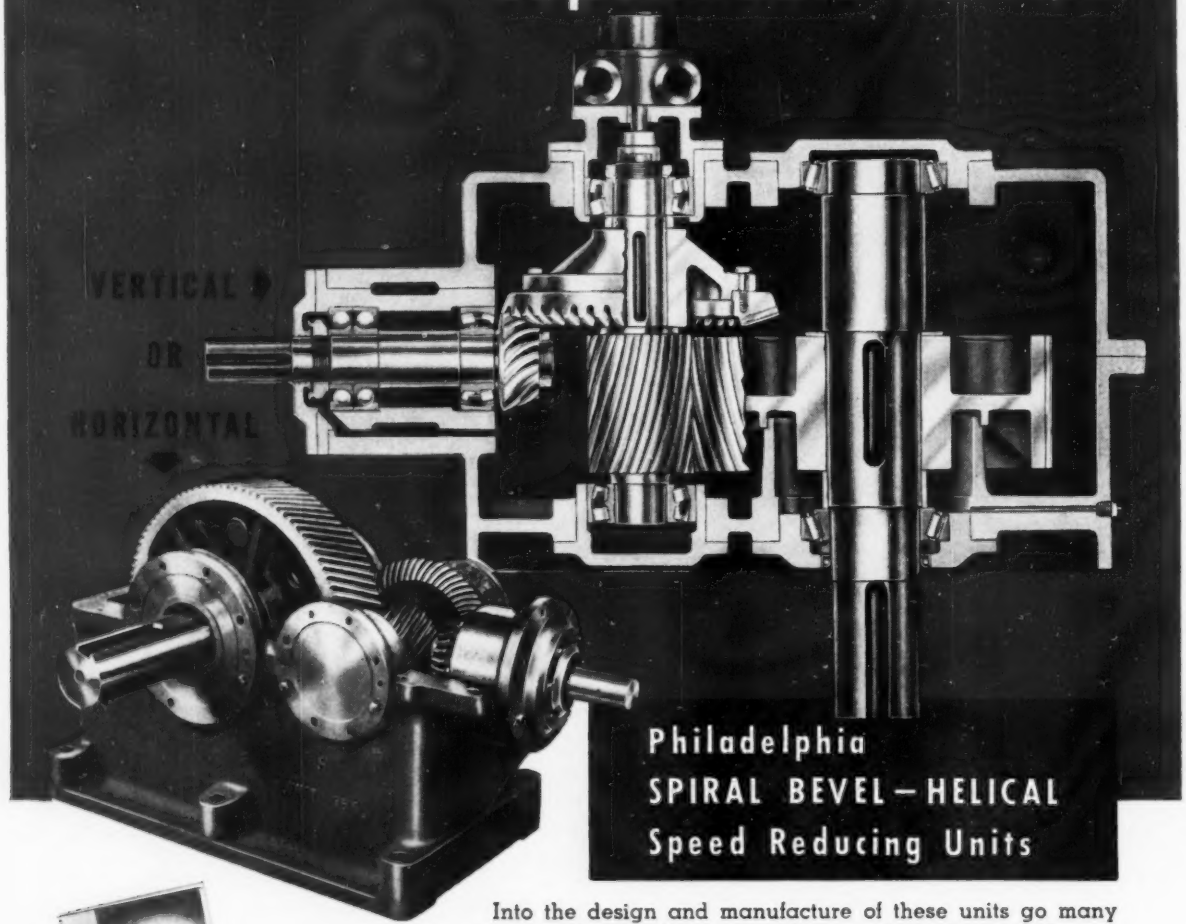
Outstanding advantages of ELECTRUNITE Pressure Tubes are faster and easier installation —due to their consistent uniformity of wall thickness, concentricity and ductility . . . and long trouble-free service life—because each tube is strong, sound and free from scabs and slivers, both inside and out.

More than 250,000,000 feet of *modern* ELECTRUNITE Pressure Tubes have been installed in countless types of steam generating and heat transfer equipment used throughout all industry. For complete information about the ELECTRUNITE Process and ELECTRUNITE Pressure Tubes, write for a *FREE* copy of Booklet BT-12.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

Republic
REPUBLIC STEEL
ELECTRUNITE

Definitely designed for dependable service



Philadelphia SPIRAL BEVEL—HELICAL Speed Reducing Units

Available in single, double and triple reductions in standard ratios up to 238 to 1. Send for Catalog SB-50.

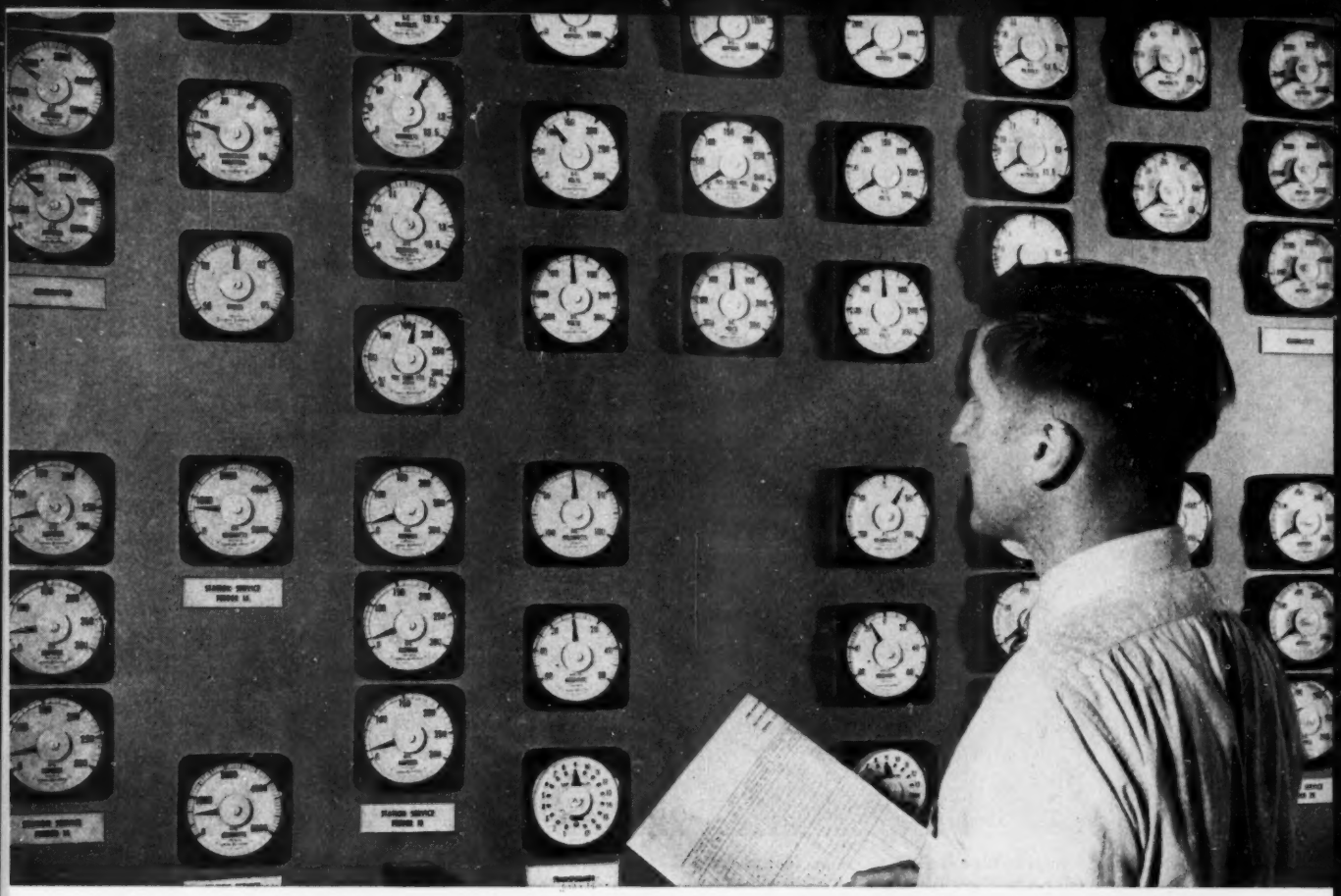
Into the design and manufacture of these units go many years of specialized experience and engineering knowledge. From the size and contour of the housings to the proper selection and placement of gears and bearings, greatest care is given to insure economical and reliable transmission of power with minimum maintenance. Indicative of advanced designing is the dry well construction which prevents oil-drip around the output shaft of the vertical unit.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

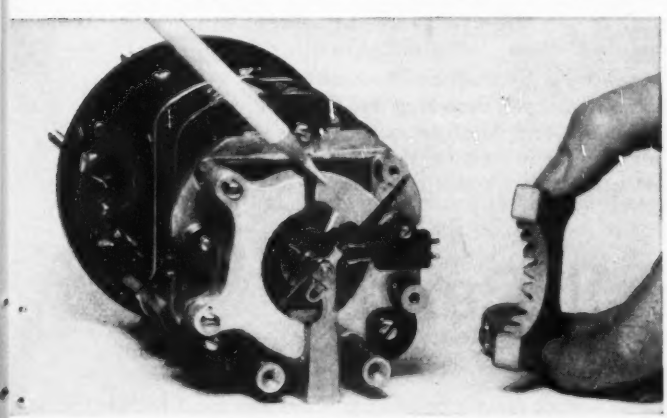


OPERATORS TAKE READINGS QUICKLY AND EASILY WITH GENERAL ELECTRIC TYPE AB-18 SHADOW-PROOF SWITCHBOARD INSTRUMENTS

G-E Long-scale Instruments Provide Improved Repeatability, Sturdiness

Now you can be assured of dependable, accurate, and consistent readings with G-E switchboard instruments. These small-sized instruments are for general service on both large and small equipment, such as control stations, testing devices, and other installations where space is limited.

REPEATABILITY is obtained with G-E long-scale instruments because they are magnetically damped to give consistent readings. You get the same reading time after time.



UNIFORM MAGNETIC DAMPING for full-scale operation permits fast pointer response without overshoot and cuts down pivot wear.

STURDINESS is obtained from strong cast-aluminum frames and shafts. The expansion rates being the same, pivots are prevented from coming loose or jamming. The one-piece, all-metal scale plate withstands abnormal humidity and temperature conditions.

SHADOW-PROOF COVER assures you of easy readability. Cover overhang and overhead-lighting shadows are eliminated because the dial is set flush with the front of the case A protruding convex-glass cover gives all-around illumination, which assures legible figures.

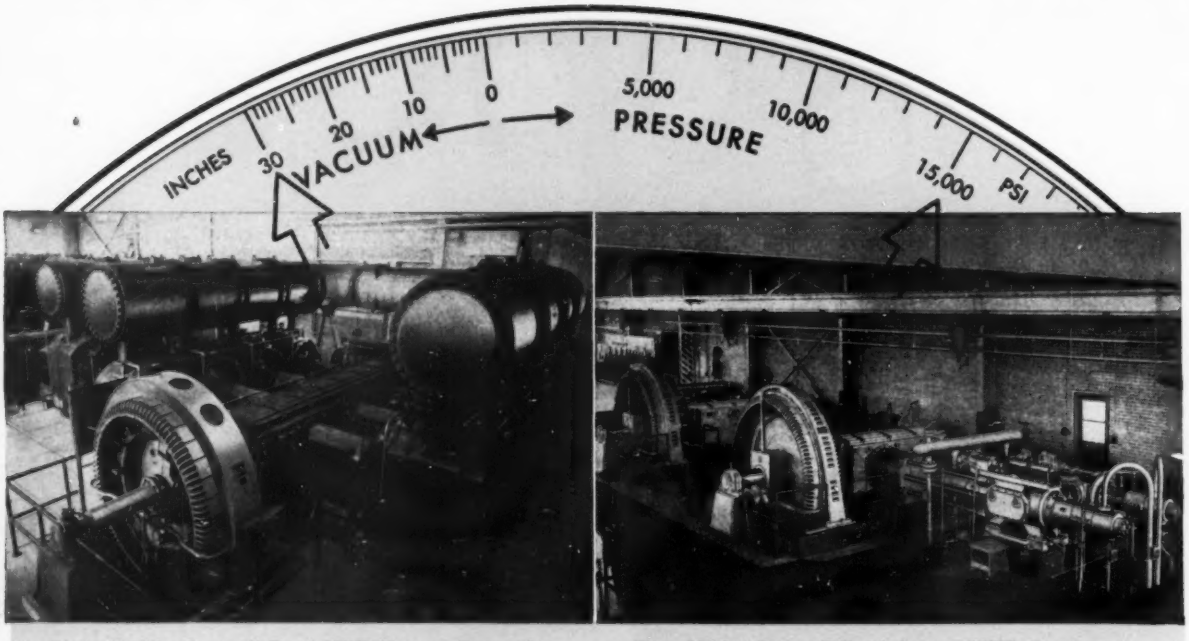
COMPLETE INSTRUMENT LINE is available. You can get G-E shadow-proof instruments in both 4¼-inch (Type AB-18) and 8¾-inch (Type AB-16) sizes. Available as ammeters, voltmeters, and wattmeters; frequency and power-factor meters; temperature indicators and synchroscopes.

FOR MORE INFORMATION write or call your nearest G-E apparatus sales office. Write for Bulletin GEC-218, General Electric Co., Section 602-251, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

any pressure or vacuum you want—



Three 2000-hp Ingersoll-Rand HHE Vacuum Pumps for exhausting testing chambers to simulate high altitude flying conditions. Piston displacement of 51,508 cfm is believed largest built to date in reciprocating equipment.

Two 900-hp Ingersoll-Rand 2-stage HHE Compressors boosting a mixture of hydrogen and nitrogen from 3500 to 15,000-psi pressure in the manufacture of synthetic ammonia. Two 2250-hp 4-stage units handle the primary compression to 3500 psi.

from high vacuums to 15,000 psi pressure

Ingersoll-Rand Compressors meet industry's exacting needs with traditional I-R economy, dependability and low maintenance.

When a southern chemical corporation wanted to compress nitrogen and hydrogen to 15,000 psi in the production of synthetic ammonia, Ingersoll-Rand compressors were chosen for the job. When the aircraft industry needed big vacuum pumps to exhaust testing chambers in order to simulate high altitude flying conditions, again Ingersoll-Rand equipment was selected.

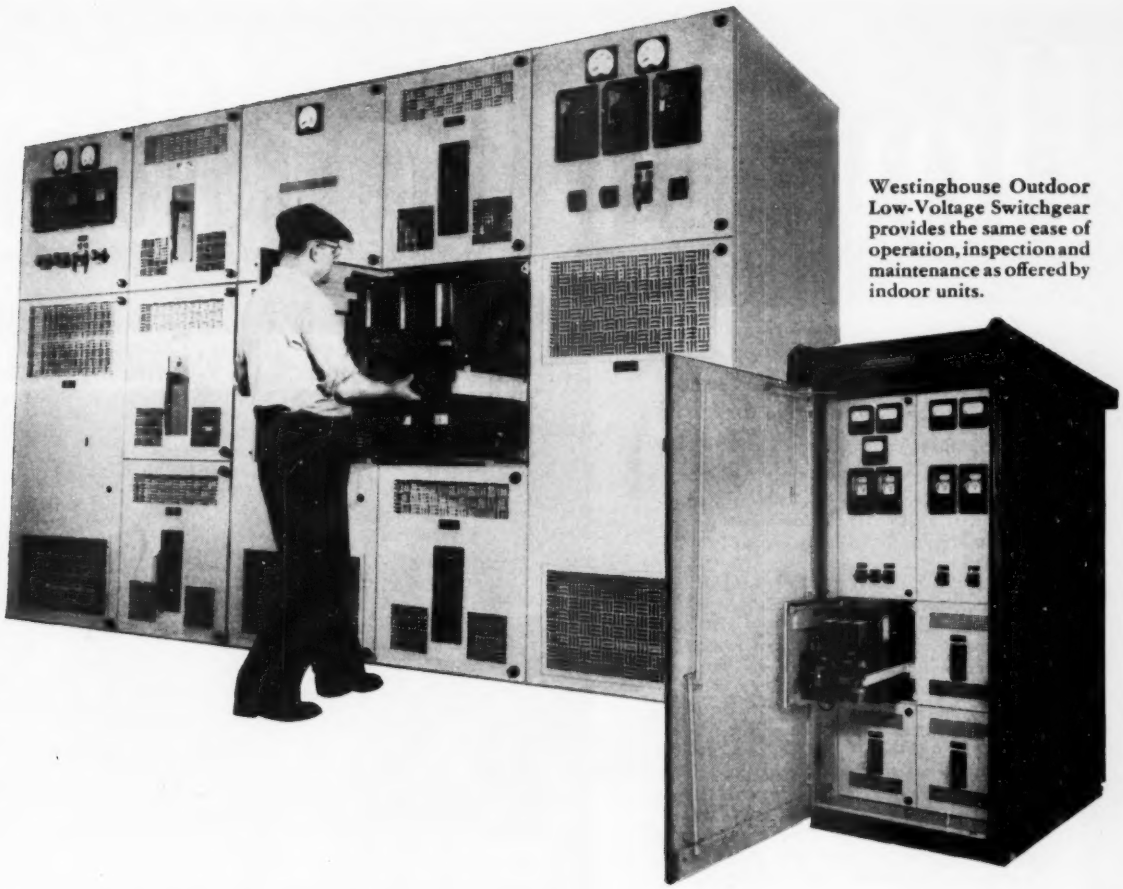
The installations pictured here are typical of the wide range of specialized services that I-R compressors are performing.

If you have a problem involving the compression or evacuation of air or gases, remember that for scores of years Ingersoll-Rand has been designing and building reciprocating, centrifugal, and steam-jet equipment—and combinations of these—to meet the most exacting requirements in all kinds of industries. Your I-R representative is well qualified to give you expert assistance, no matter what the gas, pressure, or process.

Ingersoll-Rand

833-1 11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • PUMPS • AIR AND ELECTRICAL TOOLS • VACUUM EQUIPMENT • ROCK DRILLS • CONDENSERS • GAS AND DIESEL ENGINES



Westinghouse Outdoor Low-Voltage Switchgear provides the same ease of operation, inspection and maintenance as offered by indoor units.

Now . . . flexible protection in less space

WITH WESTINGHOUSE LOW-VOLTAGE SWITCHGEAR

When you specify Westinghouse Low-Voltage Switchgear you get the most flexible low-voltage circuit protection available today. And you get it in compact, unitized enclosures that save valuable plant space . . . save you considerable planning expense . . . can be installed in a matter of hours.

An unusual degree of flexibility results from the modern selective tripping feature of the DB De-ion® Breaker. In a single, compact device, you get the perfect co-ordination of time-delay characteristics, which confines outages to the faulted section alone, to assure maximum continuity of service.

The Westinghouse Low-Voltage Switchgear design provides easy access to all components . . . simple drawout breaker operation . . . a complete metal enclosure for safety. It is available for circuits up to 600 volts, 15,000 to 100,000 amperes interrupting duty, for indoor or outdoor service.

For complete information on Westinghouse Low-Voltage Switchgear, write for Booklet B-5282. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60794

DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

YOU CAN BE SURE... IF IT'S Westinghouse LOW-VOLTAGE SWITCHGEAR

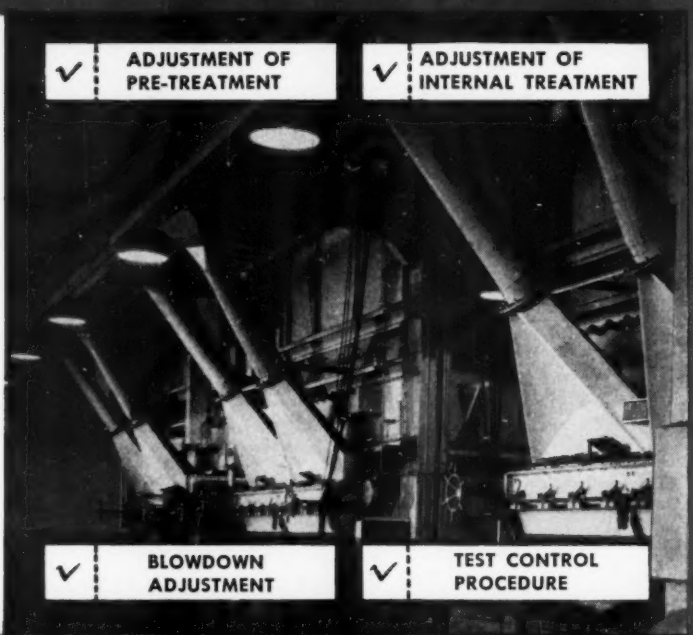
How to Combat

with Dearborn's complete water treatment and engineering service

Providing trouble-free water—a vital necessity to every user of steam—has been Dearborn's business for more than 65 years.

Today, this broad background of experience—plus treatment formulas that have been tested and re-tested and the most modern laboratory and research facilities—are available to you at Dearborn.

To keep your power and steam-producing facilities at peak production... to greatly minimize unnecessary maintenance—call your Dearborn Sales Engineer. He's our expert who will check your facilities—analyze your raw water—recommend the proper treatment, feeding equipment and test procedure. Dearborn Bulletin 5000 completely describes this service.



with Dearborn Engineered treatment equipment

Plus results from water treatment frequently depend on feeding equipment.

Here, too, Dearborn can help you. Your Dearborn Sales Engineer will inventory your existing equipment... your plant layout...then make recommendations to help you increase efficiency by including a pump or timer...a test cabinet...or an automatically controlled feeding system. Ask for Bulletin 5000.

Dearborn

TRADE MARK

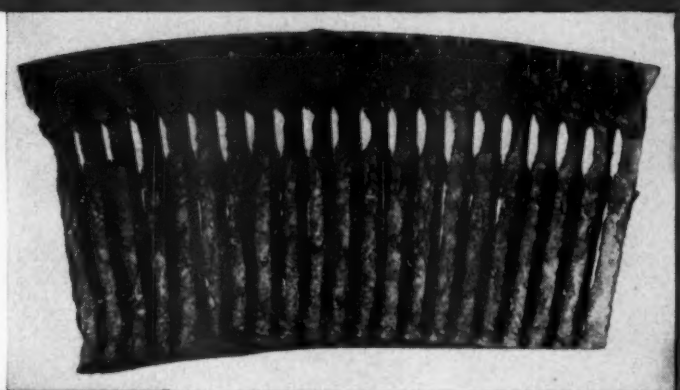
COMBATTING CORROSION EVERYWHERE SINCE 1887

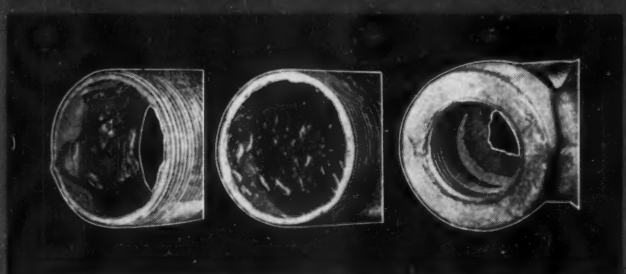
DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

Water Problems

with Dearborn polyamide anti-foams

Equipment-damaging sludge formations in feed lines, heaters, generators can be eliminated with Dearborn Polyamide Anti-Foam No. 659. Prevents carry-over of suspended and dissolved solids... conditions sludge ... is compatible with other treatment. Dearborn Bulletin 5008 demonstrates how you can have this purer steam.





with Dearborn Filmeen to prevent return line corrosion

Replacement of valuable parts—destroyed after but a short service life—could have been prevented with Dearborn Filmeen... an exclusive Dearborn development that forms a continuous amine-type film on return lines to prevent corrosion. Dearborn Bulletin 5013 tells the complete story.

Greater Pittsburgh airport is protected by Dearborn's anti-corrosion services

To eliminate corrosion and reduce maintenance expense, the new, greater Pittsburgh Airport relies on many Dearborn water treatment and rust preventive products and services. Your Dearborn Sales Engineer will do the same for you... call him... no obligation, of course.

DEARBORN ALSO SUPPLIES

- New, High-Capacity Exchange Minerals
- De-Ionizing Systems and Zeolite Softeners
- Dearsol—The New Fuel Oil Additive

MAIL THE COUPON

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza, Chicago 54, Ill.

Please send me:

☐ Bulletin 5000 ☐ Bulletin 5013
☐ Bulletin 5008 ☐ Have a Dearborn Sales Engineer call

Name.....

Company.....

Position.....

Address.....

City.....*Zone*.....*State*.....

This is what Worthington means by a "complete line" of rotary pumps...

Here's one rotary pump line that covers more applications than any you can find anywhere. Whether you pump thin, non-lubricating liquids or viscous liquids, small or large capacities, low or high pressures, with motor, turbine, engine, belt, or variable speed motor drive, there's a Worthington rotary that'll do your job. Units supplied with either conventional stuffing or mechanical seal. Write for Bulletin W-485-B1 on vane types; W-484-B1A (general service—capacities to 51 gpm, pressures to 100 psi), W-484-B2 (corrosive service—capacities to 51 gpm, pressures to 100 psi), and W-487-B10C (heavy-duty service—capacities to 5,000 gpm, pressures to 500 psi) all heavy-duty gear types. Worthington Corporation, Reciprocating Pump Division, Harrison, N. J.

P.2.4

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Rotary Pumps

User Explains How Armstrong Unit Trapping Boosted Output:

Need for Investment in New Steam Equipment Eliminated by Only $550.00 in Steam Traps

THIS is a story about greatly increased efficiency in a laundry, but the principles involved apply to any plant using steam heated equipment.

In speaking of the benefits derived from Armstrong Unit Trapping, Earl Fast of Soft Water Laundry and Cleaners, Long Beach, California, said, *"It's like a man with dirty eyeglasses—he thinks he's seeing perfectly until he cleans the glasses and finds out what he has missed."*

Mr. Fast's plant modernized its entire return system in 24 hours, installing 71 Armstrong traps costing about $550, with these results:

1. Capacity of machines costing as much as $15,000 per unit increased to the extent that new machines are not now required.
2. Higher quality of ironing and finishing, with touch-up on shirts eliminated.
3. Worthwhile fuel savings.

"Our boiler was turning out plenty of steam," continued Mr. Fast, "but we weren't getting the benefit of it. The best power plant in the world is of no value if you don't use its produced steam to maximum efficiency."

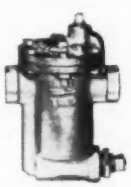
And there lies the case for Armstrong Unit Trapping, which discharges air and condensate as fast as it accumulates to keep steam heated equipment hot and producing at a peak rate. Your local Armstrong Representative will be glad to survey your condensate drainage system without obligation. Call him or write:

ARMSTRONG MACHINE WORKS

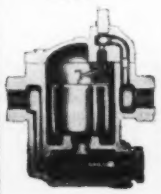
812 Maple Street • Three Rivers, Michigan

Traps with Built-in Strainers Cut Costs

Because the piping at Soft Water Laundry was old, the smallest-sized traps needed protection against dirt and scale. Armstrong No. 880 and 881 traps with built-in strainers were the logical answer because:



1. They cost less than a separate trap plus a strainer.
2. They eliminate external fittings and considerable installation labor.



Left—Cut-away view showing strainer screen at trap inlet. Strainer can be cleaned without removing or shutting off steam.

You always get more out of equipment when you use Armstrong "Unit Trapping"

FREE
44-PAGE STEAM TRAP BOOK
Gives Complete Information
MAIL TODAY!

FILL IN AND CLIP TO YOUR COMPANY LETTERHEAD

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan
Please send me a Steam Trap Book.

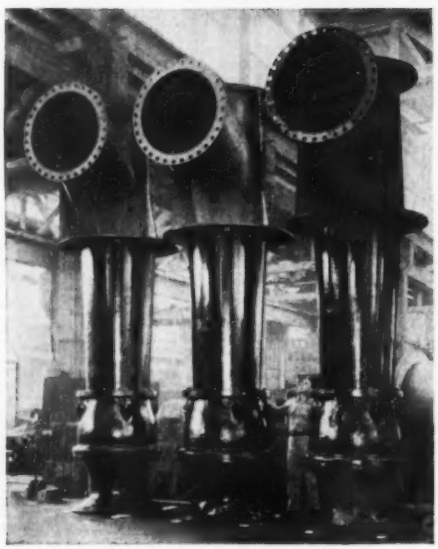
Name .....

Title .....

NOTES

for the engineer's note book

...ON
WHEELER-ECONOMY
POWER PLANT
EQUIPMENT



INCREASE OPERATING DEPENDABILITY WITH WHEELER-ECONOMY PUMPS

Wheeler-Economy Pumps Designed Particularly for Power Plant Application Include:

CIRCULATORS

Mixed Flow, Vertical Wet Pit, Standard and "Pull-Out" Types
Mixed Flow Volute, Dry Pit Type
Horizontal Double Suction

CONDENSATE PUMPS

Multi-Stage Horizontally Split Case
Vertical Barrel Type

36" mixed flow condenser cooling water circulating pumps (illustrated) ready for day-in day-out 24-hour service. These circulators have a capacity of 28,000 GPM at 45' head. Driven by 400 HP motors at 585 RPM. Circulators are offered in standard sizes from 1000 GPM to 100,000 GPM and may be furnished on special order for capacities up to 200,000 GPM.

Wheeler-Economy Pumps for General Service Power Plant Operation Include:
Single Stage High Head Double Suction; Multi-Stage Horizontally and Vertically Split Case; Process; Sump; Heating and Fire Service.

BE SURE OF PEAK PERFORMANCE WITH C. H. WHEELER CUSTOM-BUILT CONDENSERS

The thinking of C. H. Wheeler's experienced engineers is not confined to any standard or special type of condenser. They study all the conditions surrounding your requirements—such factors as source, quantity and quality of water supply, etc. The C. H. Wheeler Steam Condenser they subsequently recommend and design for you is, therefore, custom-built for every contingency that might arise. Initial cost is soon paid for and you enjoy the peace of mind that goes with sustained peak performance. Write for bulletin, "Self-Cleaning Steam Condensers with Reverse Flow."

GET MORE EFFICIENCY AT LOWER COST WITH C. H. WHEELER TUBEJETS

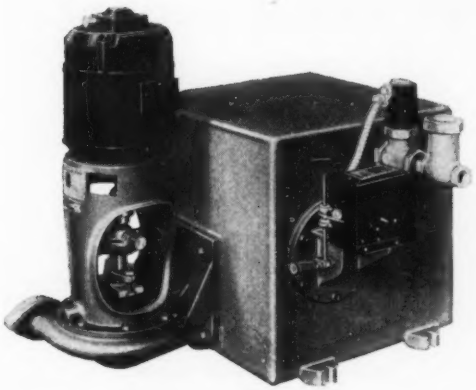
The C. H. Wheeler Manufacturing Company has been foremost in the development of steam jet ejectors, winning engineering awards and world-wide distinction in this field. The C. H. Wheeler Tubejet is a highly reliable vacuum pump. It is easy to install and maintenance costs are low. Long life is assured because the Tubejet has no moving parts. Tubejets are easily arranged in a variety of combinations of single or multi-stage units with inter- and after-condensers to meet all conditions. Write for CATALOG #1462.

C. H. WHEELER of Philadelphia

C. H. WHEELER MANUFACTURING CO., 19TH AND LEHIGH, PHILADELPHIA 32, PA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Cooling Towers • Vacuum Refrigeration
High Vacuum Process Equipment • Micro-Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery

. . . ON WHEELER-ECONOMY HEATING PUMPS



SAVE COSTS IN HOT WATER OR STEAM HEATING

HOT WATER—Wheeler-Economy Hot Water Circulating Pumps can be furnished in a large range of types and capacities for economical, efficient use in panel, base board, radiant and all hot water heating systems.

STEAM—For steam heating systems, specify and use Wheeler-Economy Vacuum Pumps and Return Condensation Pumps to obtain top quality performance and reliability. You can count on an open system, free of condensate, at all times.

With Wheeler-Economy Heating Pumps on the job, savings in fuel, efficient BTU delivery and low maintenance pay you important dividends season after season. Our engineers and distributors will be glad to help you on pump specifications. Write for Bulletins on the extensive Wheeler-Economy Heating Pump line and location of nearest distributor.

(Note to Distributors: Some choice territories are still open.)

WHEELER-ECONOMY PUMPS

Division of C. H. Wheeler Mfg. Co.
Philadelphia 32, Pa.

. . . ON Klipfel FLOAT VALVES

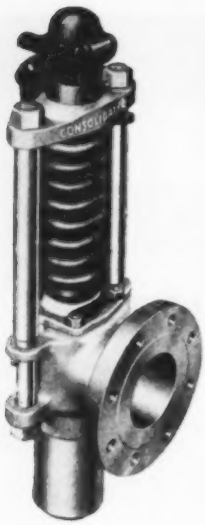
Klipfel WORRY-PROOFS YOUR LIQUID LEVEL CONTROL PROBLEMS

In many cases, you can save money by installing a good mechanical Klipfel Float Valve instead of an intricate, instrumentated controller. Your Klipfel Engineer or distributor can recommend Float Valves that literally "worry-proof" your liquid level control problems. To meet all requirements—pressure, temperature, type of fluid and closure—Klipfel Float and Lever Valves are made in 17 standard styles with a good range of sizes in each style. You can get a Klipfel Float and Lever Valve as small as ⅜" and as large as 12". Either direct acting or pilot control, and single or double seated types offer additional flexibility to meet any set of conditions.

Many thousands of installations—large and small—in water and chemical services—have proved the quality of Klipfel design and workmanship over the past 40 years. Write for BULLETIN #349 which contains really useable information on the selection of float and lever valves.

Klipfel VALVES INCORPORATED

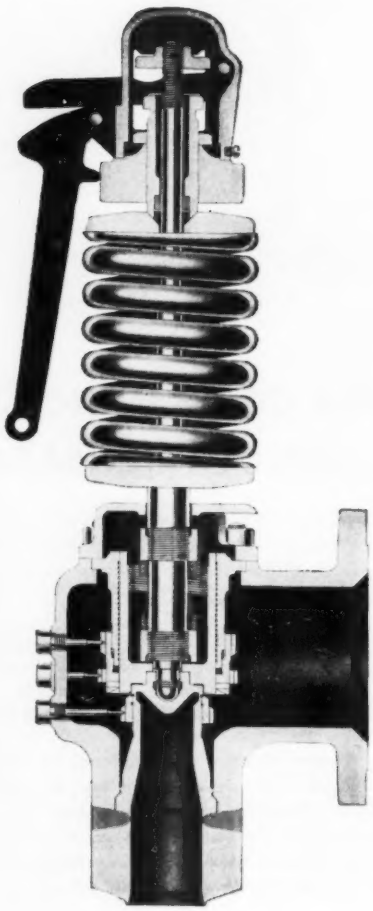
HAMILTON, OHIO



MAXIMUM FLOW...

CONSOLIDATED *Maxiflow* SAFETY VALVES

Give you that—and more!



GREATER DISCHARGE CAPACITY that is there *when you need it*... tightness that you can depend on *month-after-month*... and other design features for high pressure, high temperature service mean one valve only — the Consolidated *Maxiflow* Safety Valve.

You can rely on the Maxiflow. Punishing laboratory tests and the toughest field services have demonstrated the functional ruggedness and dependability of the Maxiflow. Design advantages include:

Thermodisc Seat For Permanent Tightness. Equalizes temperature differentials when the valve reseats after blowing, minimizes thermal stresses, prevents seat distortion.

Design And Materials Assure Retention Of Popping Point. Special alloy steel is used to obtain stability of the spring support in the yoke rods, and a stainless steel spindle compensates thermally for any possible elongation of other parts that effect spring loading.

Controlled Blowdown. Simply and externally adjusted while the valve is under pressure.

Forged Mechanical Through Bushing. Provides constant entrance conditions for steam flow. There is no leakage due to porous castings.

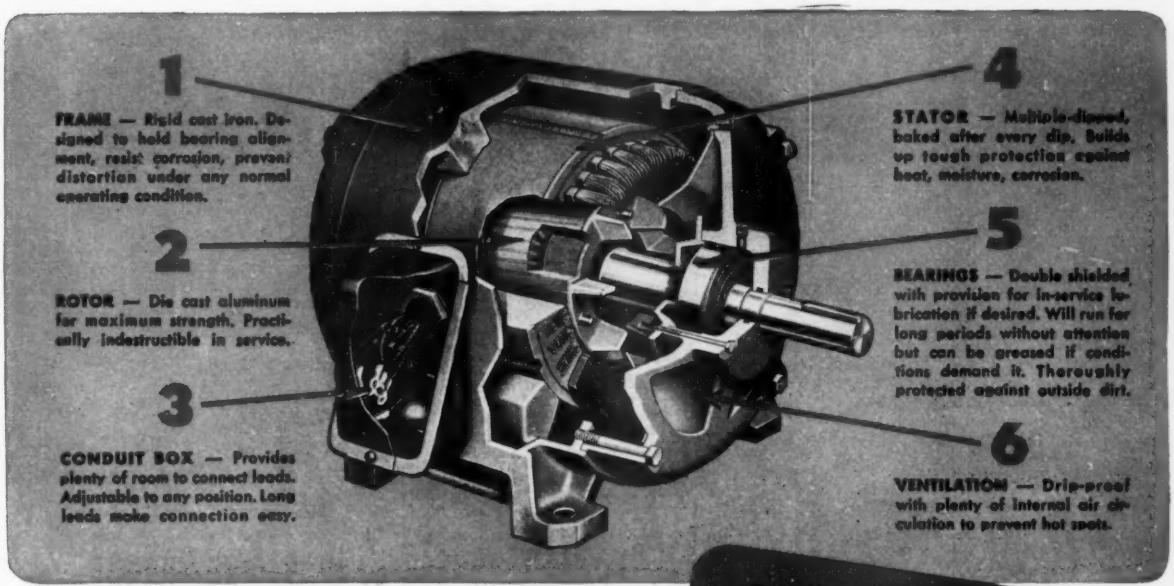
Whatever size safety valve you need — 1½", 2", 2½", 3", or 4" — choose Consolidated *Maxiflow*, the safety valve that sets a new standard in protection and service. Complete data, including capacity tables, are available in Bulletin 707. Write for a copy.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

Look for These 6 Signs of Good Motor Design


1
FRAME — Rigid cast iron. Designed to hold bearing alignment, resist corrosion, prevent distortion under any normal operating condition.
2
ROTOR — Die cast aluminum for maximum strength. Practically indestructible in service.
3
CONDUIT BOX — Provides plenty of room to connect leads. Adjustable to any position. Long leads make connection easy.
4
STATOR — Multiple-dipped, baked after every dip. Builds up tough protection against heat, moisture, corrosion.
5
BEARINGS — Double shielded with provision for in-service lubrication if desired. Will run for long periods without attention but can be greased if conditions demand it. Thoroughly protected against outside dirt.
6
VENTILATION — Drip-proof with plenty of internal air circulation to prevent hot spots.

Get Allis-Chalmers Motors for these Extra Values!

ALLIS-CHALMERS **MOTORS**

Certified Service — Nearly 100 Allis-Chalmers Certified Service Shops provide factory-approved parts and service on your Allis-Chalmers motors. Screened for modern equipment, adequate experience and business integrity, these independently owned service shops will provide you with prompt, economical repair and maintenance.

Complete Drives from One Source — Allis-Chalmers can supply your complete drive — motor, control and *Texrope* V-belt drive — from one convenient, reliable source.

Application Engineering — Your Allis-Chalmers District Office representative or Authorized Dealer will be glad to help you select exactly the right motors for your needs. For additional information, write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B6052. A-3954

Texrope is an Allis-Chalmers trademark.

Sold . . .
Applied . . .
Serviced . . .

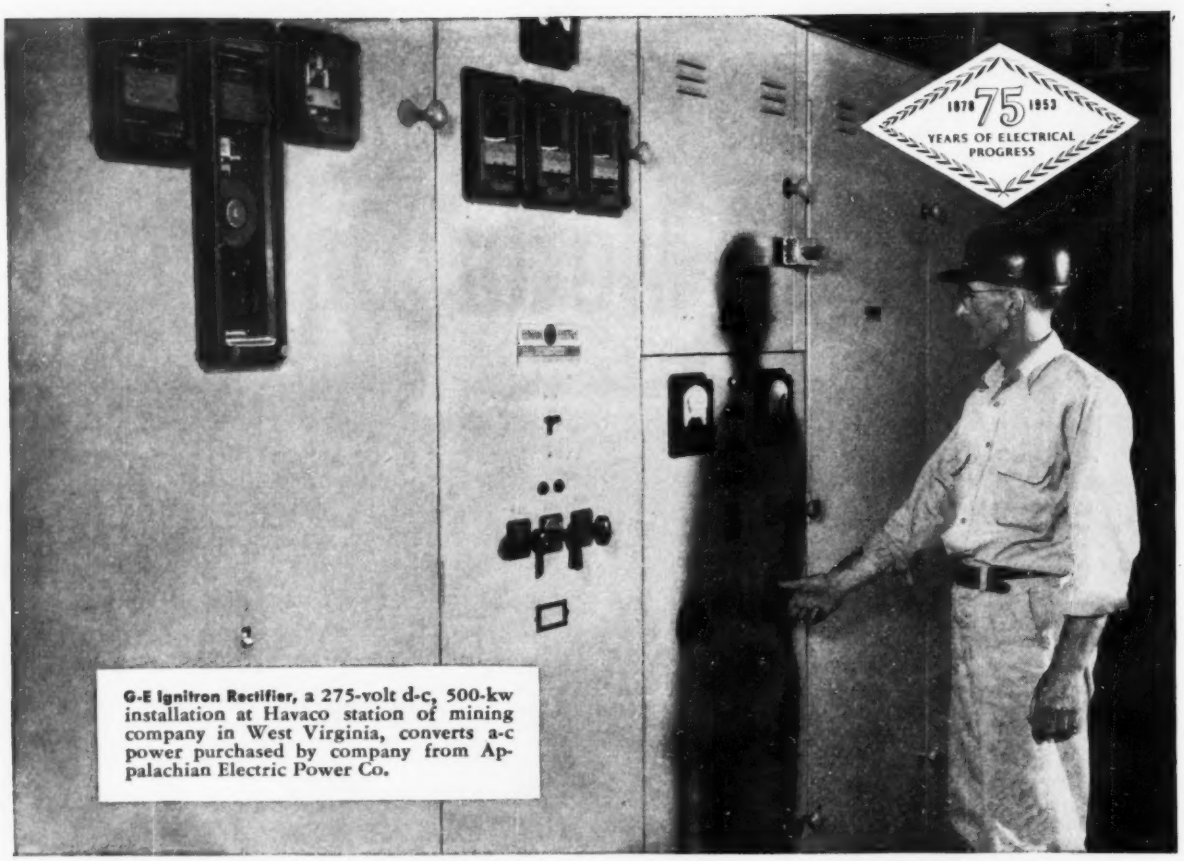
by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

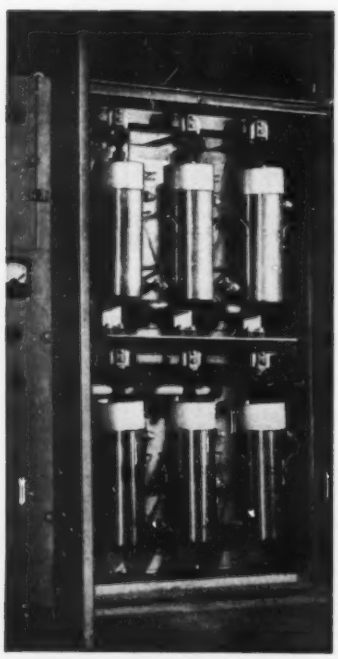
PUMPS — Integral types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS



G-E Ignitron Rectifier, a 275-volt d-c, 500-kw installation at Havaco station of mining company in West Virginia, converts a-c power purchased by company from Appalachian Electric Power Co.

8 years of dependable operation



Six tubes for power. Rectifier features simple design, no major moving parts to wear out.

G-E Ignitron Power Rectifiers, requiring minimum maintenance, operate at top efficiency under rugged mining conditions.

For round-the-clock service, year in and year out, G-E Ignitron Rectifiers give dependable d-c power under most adverse circumstances.

In the mountainous, isolated areas of West Virginia's mining country, for example, seven General Electric rectifier substations, all equipped with Ignitron Rectifiers, have serviced mines of a large coal producing company in the New River and Pocahontas fields since 1944. And over this 8-year period, the company reports, the G-E Ignitron Rectifiers have given safe, and near continuous service—with very low overall maintenance costs.

Proved-in-service G-E Ignitron Rectifiers are chosen for these hard jobs because they provide maximum protection to operating personnel . . . possess an efficiency generally higher than rotating power-conversion units . . . have no major moving parts that need replacement or require extensive upkeep. And they are reliable. If regular inspection periods are maintained, G-E Ignitron Rectifiers can be left unattended, for months at a time, with the assurance they will give satisfactory service during all that period. Supplied as a complete packaged unit with transformer and metal-enclosed switchgear, the installation occupies minimum space.

Call or write your nearest G-E sales office for information on a G-E Ignitron Rectifier to fi: your d-c power requirements. General Electric Company, Schenectady 5, N. Y.

3244

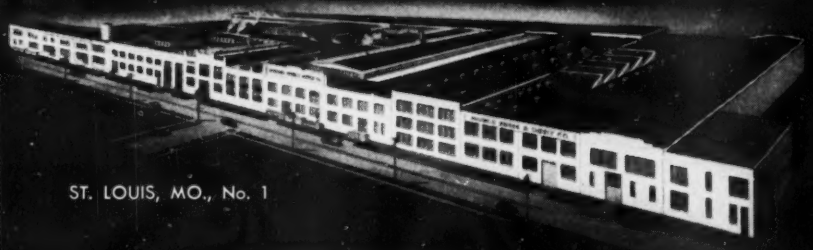
GENERAL ELECTRIC

Users of Piping

whether a simple bend welded assembly or

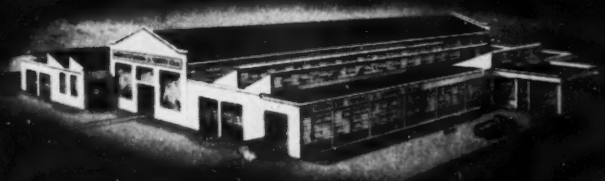
complete piping systems for power plant or process

Get Multiple Advantages from MIDWEST Multiple Plants

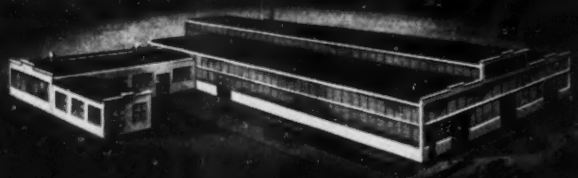


ST. LOUIS, MO., No. 1

ST. LOUIS, MO., No. 2



LOS ANGELES, CALIF.



PASSAIC, N. J.

BOSTON, MASS.

Strategically located multiple plants and large scale operations have made it economically practicable for Midwest to develop much special pipe fabricating machinery and to conduct piping research that would be impossible under other circumstances. Multiple plants create a friendly rivalry between the organizations of these plants that advances the art of piping fabrication more rapidly than would otherwise occur. All these activities are reflected in better fabricated piping . . . in greater piping value per dollar. • Multiple plants help make Midwest the preferred source for prefabricated piping.

MIDWEST
PIPING & SUPPLY
COMPANY, INC.

PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN 50 YEARS

Reduce Solids Concentration *with* EFFECTIVE BLOWDOWN

COMPLETE TEST KITS for making standard feedwater and boiler water tests are supplied by Allis-Chalmers for field use. When needed, modern testing equipment and research facilities are available in A-C laboratories.

You Need An Effective blowdown schedule to reduce solids concentration and limit heat losses in your system. Planning your schedule is easier after you've read Allis-Chalmers water conditioning Bulletin 53. It tells how to choose between a manual and a continuous system. It explains factors involved in sludge removal. And it discusses effects of alkalinity and silica concentration.

Part of Practical Library

Bulletin 53 is one of a series of Allis-Chalmers bulletins on water conditioning problems. These bulletins are the result of Allis-Chalmers experience in solving water problems for every industry, as well as the company's long background in the design and manufacture of steam turbine and power plant equipment.

Get Complete Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in all water treatments. And you can get equipment needed for any system.

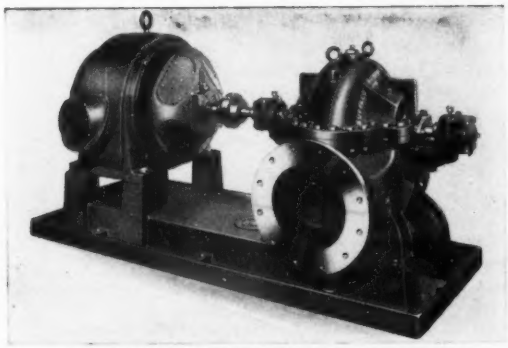
For your copy of Information Bulletin 53 on blowdown, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers representative consult with you on your water problems.

A-4008

ALLIS-CHALMERS

"Buffalo" *Tips on Better Pumping*

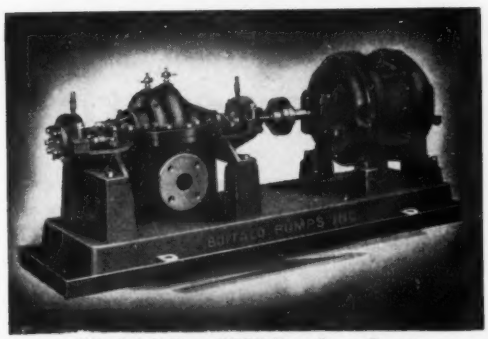
ADVANTAGES of 3 TYPES of CENTRIFUGAL PUMPS



"Buffalo" Type "SL" Double Suction Pump

DOUBLE SUCTION — EFFICIENT IN MOVING HIGH VOLUMES — IMPELLER SUPPORTED FROM 2 SIDES

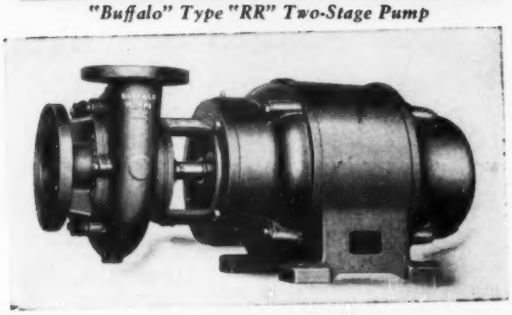
Taking in clear water from both sides of its enclosed double suction impeller, this "Buffalo" Type "SL" Pump is ideally suited to handling large volumes efficiently. Correctly formed water passages and perfect hydraulic balance add to its efficiency. Bearings on both ends of oversize impeller shaft assure maximum life. Large capacity range, from 10 to 10,000 gpm, for air washers, chilled water, humidifier, general service. Write for Bulletin 955-P.



"Buffalo" Type "RR" Two-Stage Pump

MULTISTAGE — EFFICIENT DESIGN FOR HIGH PRESSURES

"Buffalo" builds these durable, easy-to-maintain pumps in two and four stages for heads up to 1500'. Each additional stage develops additional pressure, a highly desirable feature for jobs such as boiler feed. Impeller receives ideal support from bearings on both sides. Horizontally split shell provides quick accessibility. For further details, write for Bulletin 980.



"Buffalo" Type "CCL" Pump

CLOSE COUPLED — SPACE SAVING — PERMANENT SHAFT ALIGNMENT

Available in all iron or special alloys, these husky single suction pumps are built as a unit—require no alignment during installation or afterwards. Each design—single suction, double suction, multistage—offers particular advantages. "Buffalo" builds all types, to give you the best possible pump for your job. Write for details on the full line.

"Buffalo" BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Application engineering . . . *essential to control*

No matter what the product, every plant uses methods, materials and equipment that present problems peculiar to its own production. Specifications . . . size of plant . . . rate of output . . . all impose further unique restrictions.

What, then, about process control instrumentation? To do its job right, it has to be designed with all those factors . . . and many others . . . in mind. And here is where Honeywell Application Engineering steps in.

First comes a thorough investigation of control requirements. A Honeywell engineering representative, well versed in instrumentation techniques sits down with process engineers, production men, and instrument technicians . . . discusses details of the specific process. Then he puts the problem up to Honeywell's staff of application engineers.

Specialists for Each Industry

In this group are men who are expert in each specific industry. One group, for example, specializes in instrumentation for the metalworking industry . . . another for chemical . . . another for petroleum . . . until the whole gamut of modern manufacturing is represented. Each man has been trained, by education and first-hand experience, in the techniques of processing and process control in the area of his interest. Each is a living part of the industry he serves. And he knows why and where every process "is different."

Covers All Aspects of Control

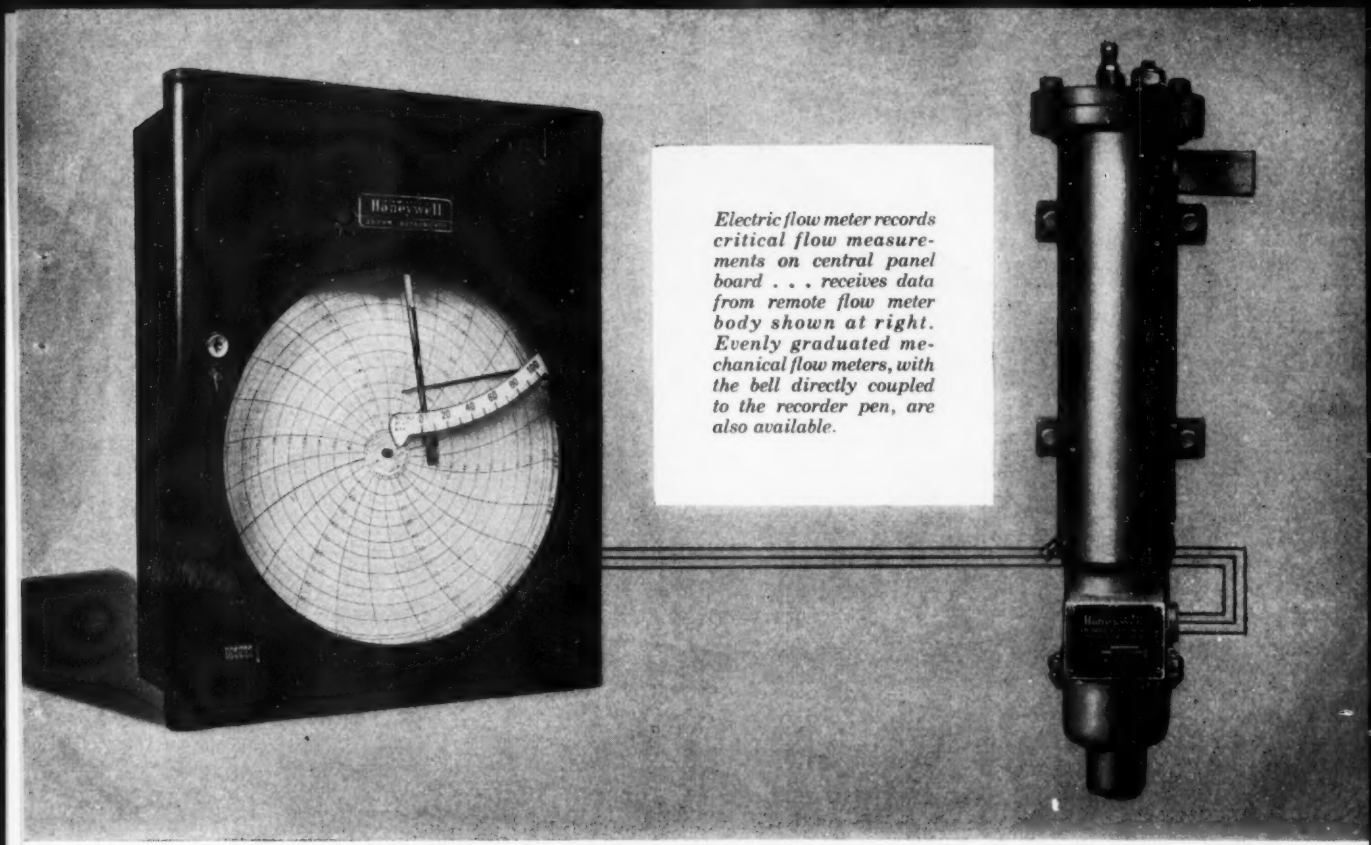
Honeywell application engineering covers the entire control installation. It works out details of what instrument to use for each measurement or control function . . . what type of primary element . . . what control system . . . what size and style of valve. It provides all essential signals, safety interlocks, and accessories. It combines all these elements into a complete unit, arranged for peak production efficiency . . . greatest convenience of the operator, and for maximum ease of service . . . custom-fitted to the individual needs of the process to be controlled.

Saves Time . . . Produces Top Performance

This Honeywell service gives specialized consultation on complex control problems that would otherwise require the attention of experts in the individual plant. But most important, it assures a control system that will produce the superior performance that Honeywell instruments are capable of giving . . . and which will help to obtain the most production and best quality from the process which it serves.

Choose the *for easy*

SOUND PLANNING, *based on specialized engineering experience, forms the basis of Honeywell Application Engineering. Here a round-table discussion between customer and Honeywell technicians irons out the initial control requirements for a process.*



Electric flow meter records critical flow measurements on central panel board . . . receives data from remote flow meter body shown at right. Evenly graduated mechanical flow meters, with the bell directly coupled to the recorder pen, are also available.

Brown Electric Flow Meter

reading . . . accurate integration

ACCURATE information on steam and water flow at vital points in the plant is always at your fingertips when you use the Brown Electric flow meter. Electric transmission brings data accurately, instantaneously from the point of measurement. This instrument's evenly graduated scale and chart provide easy readability and consistent accuracy at all flow values . . . invaluable in cost accounting and heat balance calculations.

The built-in electronic integrator sets a new standard of precision and simplicity. It scans at a rate of twelve times per minute—detects every significant flow change . . . measures on a 6-digit counter. The entire assembly has only three major parts, all accessible for quick checking and calibration.

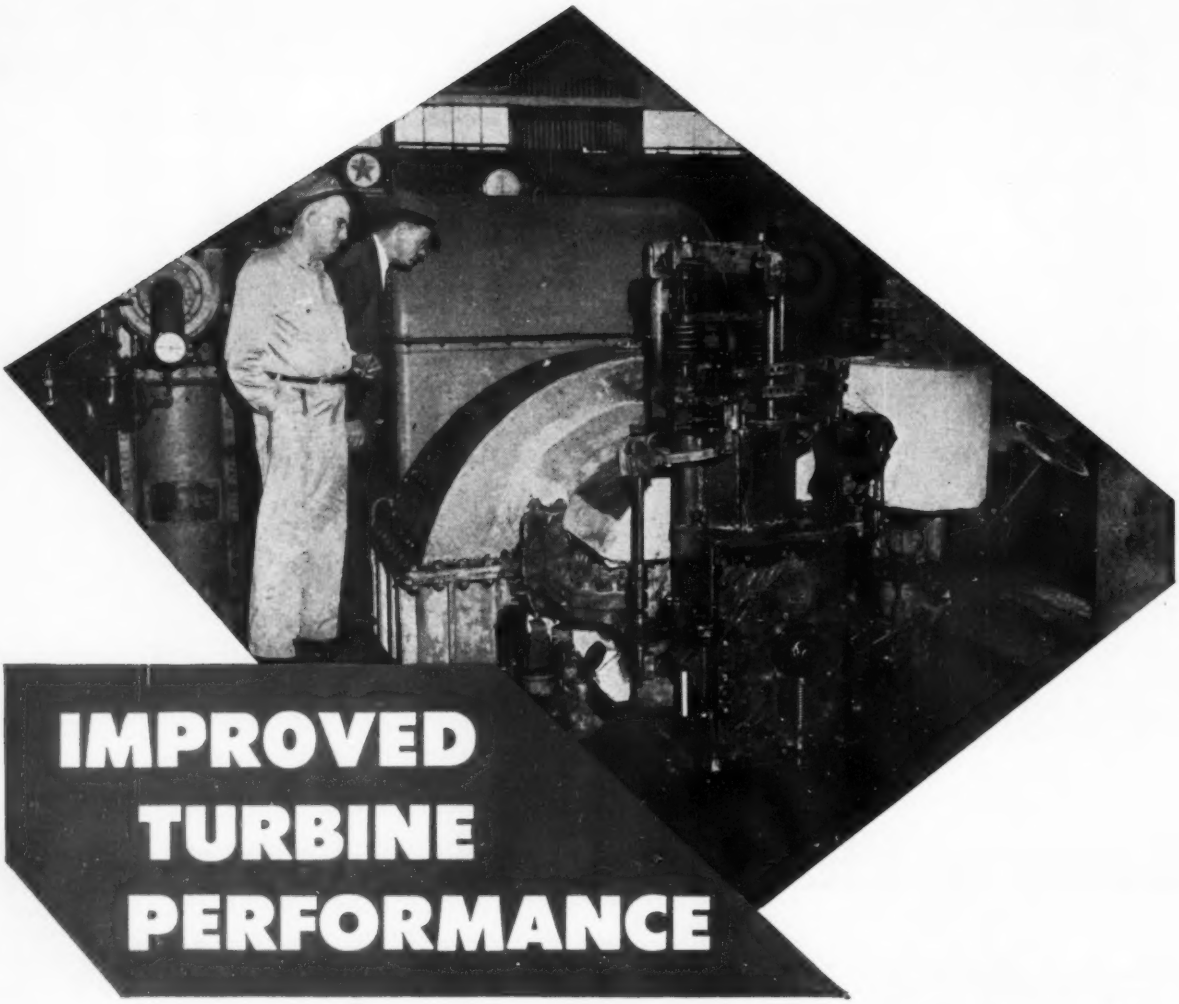
The meter body features corrosion-resistant, light weight design . . . has a characterized bell . . . designed to provide the utmost accuracy.

Our local engineering representative will be glad to discuss applications to your plant's flow-measuring problems. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Catalog 2300, "Evenly Graduated Flow Meters"... and Bulletin 90-2, "Supervisory Instruments for Power Generation."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



IMPROVED TURBINE PERFORMANCE

...assured with TEXACO REGAL OIL (R&O)

As power demand increases, so does the importance of keeping your turbines on the line. Your best assurance of doing this is to lubricate with *Texaco Regal Oil (R&O)*—the turbine oil that tests proved has more *than ten times the oxidation-resistance* of ordinary turbine oils . . . far greater ability to prevent sludge, rust and foam.

This is because — for decades before additive oils became popular — Texaco Regal Oil was a world-famous turbine oil, and *Texaco Regal Oil (R&O)* is this same fine oil *improved* with special rust and oxidation inhibitors and specially processed to prevent foaming.

Texaco Regal Oil (R&O) has an extra-long service life and you can count on it to keep lubricating systems clean, maintain normal bearing temperatures, and assure instant governor response. There is a complete line of *Texaco Regal Oils (R&O)* meeting the stringent requirements of all leading turbine builders.

A Texaco Lubrication Engineer will gladly help you select the one best suited to your particular type and size of turbine and operating conditions. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE, on television Tuesday nights. **METROPOLITAN OPERA** radio broadcasts Saturday afternoons.

Coal Power for the West?

WEST COAST ENGINEERS will be much interested in a proposal to burn coal in mammoth mine-mouth plants in Utah and transmit the resulting electrical energy more than 600 miles, at 500,000 volts, to load centers on the Coast. This could be a paying proposition by 1975, according to a study (page 90) recently made public by the U.S. Bureau of Reclamation. By that time, the Bureau predicts, the 22 states west of the Mississippi River will be consuming electrical energy at five times the present rate.

The most challenging segment of this study relates to California. By 1975, the Bureau estimates, more than half of California's power will come from coal-fired plants. This will involve burning 34 million tons of coal per year.

Granting this, the customary procedure would be to ship the coal by rail to plants in California, because it has almost invariably been cheaper (for long distances) to ship coal than to transmit the corresponding kilowatt-hours from mine-mouth plants.

Looking forward to a vast load growth and great advances in high-voltage long-distance transmission, and assuming other favorable conditions, the Bureau concludes that, by 1975, it will be cheaper to generate the power in Utah and transmit it to California. The "shipping cost" per kwhr from eastern Utah to a 230,000-volt substation near Los Angeles is given as 1.86 mills for electrical transmission and 2.19 mills for coal haulage.

To arrive at the very low figure of 1.86 mills to transmit one kwhr 660 miles, the Bureau assumes a yearly charge of only 4.75% on the transmission-line investment. This includes interest 3%, amortization 0.89%, replacement of equipment 0.74%, and "in lieu of insurance" 0.12%.

A privately owned transmission line, to provide for taxes, normal interest, etc, would have to allow 10 to 15%, which would make the electrical transmission cost far greater than that of coal haulage. We must take it that the study assumes Government ownership.

As is too often the case in such comparisons, the paper savings, based on the 4.75% rate, are largely imaginary. Take the one item of taxes, for example. Government transmission lines would necessarily displace tax-paying facilities—either privately owned transmission lines or privately owned railroad traffic. Any proper estimate of transmission costs by the use of public lines must allow for inevitable tax losses.

In the national average, each dollar paid for coal freight carries about 15 cents of tax charge, direct and indirect. Granting that it is not easy to figure how much railroad tax national, state and local governments would lose by eliminating 34 million tons per year of coal shipment from Utah to California, it is certain that an important allowance must be made for a fair comparison.

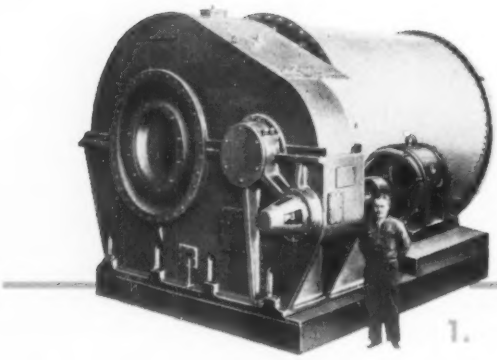
Economists could go much deeper into this matter and show that the other "savings" made possible by the abnormally low interest and depreciation rates are largely imaginary, but this is no place for a discussion of economic theory. It is enough to point out that realistic allowances for taxes, interest and depreciation would largely invalidate the Bureau's conclusion that electrical transmission would be cheaper.

Yet we would not suggest discarding this report completely. Much of value for future planning can be learned by studying its load growth and fuel-supply estimates for all the western states.

Then, too, there is always the possibility that coal haulage in 1975 may be more costly than we imagine today, or that we shall find some way to transmit electric power more cheaply than now seems possible.

We of POWER would certainly not place ourselves in the position of saying that it will never pay to generate most of California's power by burning coal in Utah. We merely say that, in our opinion, the data and the comparisons in this particular study do not lead to that conclusion.

REAL ECONOMY... with



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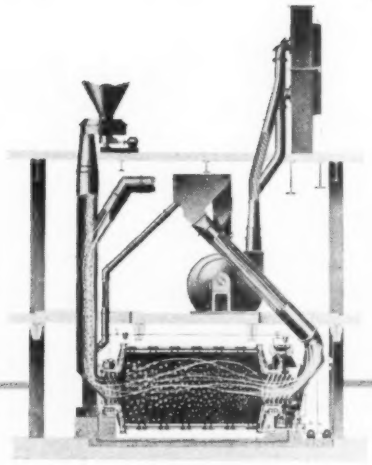


2.

COAL PULVERIZED TO OBTAIN MAXIMUM HEAT VALUE

Through the unmatched economy of the KVS Coal Firing System, plants throughout the world are realizing tremendous savings in their fuel costs.

By pulverizing coal to a fineness of 85% to 90% through a U S. standard 200 mesh screen, the KVS Coal Firing System obtains maximum heat value from every ton of coal burned. More heat means *more power* available from any given quantity of coal. No other system produces comparable results.

With the KVS system, coal firing is instantaneous, combustion complete. Unburnt carbon losses held to less than ½% *at all ratings.* Pulverized fuel instantly available to meet fluctuating loads with quick, flexible response to combustion controls. Free moisture is liberated in the mill while the coal is being pulverized.

BURNS ANY GRADE OF COAL!...CHEAPEST TO HIGHEST!

Because of the extremely fine pulverization obtained with the KVS Coal Firing System, the cheapest grades of coal provide complete combustion comparable to that obtained from more costly fuel. Tramp iron not only cannot damage the mill, but actually helps pulverization!

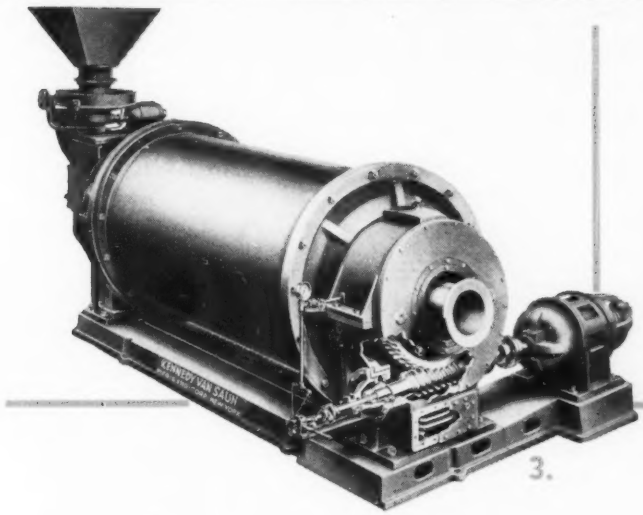
HOW DO YOUR FUEL COSTS COMPARE?

- What is your unburnt carbon loss?
- Do you pay premium prices for coal?
- What is your boiler efficiency at reduced rating?
- Do you lose coal when you change rating?
- How often do you shut down for repairs?
- Will tramp iron in coal damage your pulverizer?
- Can you afford frequent stoppages?
- What is the maintenance cost on your coal firing equipment?

GET THE FULL FACTS ON THE KVS COAL FIRING SYSTEM.

Find out how you can cut coal costs by *as much as a dollar a ton.* Send for the facts today!

KVS Pulverized Coal Firing System



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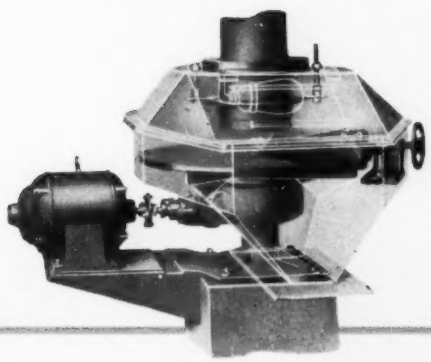

4.

1. AIR SWEPT TUBE MILL

Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.

2. COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

3. WORM GEAR TUBE MILL

The worm gear is desirable for medium and small size mills up to 66 inches in diameter and in various lengths. Worm shaft mounted in Timken roller bearings. Oil pump direct-connected to worm shaft. Complete designs for steam and coal installations.

4. DISC FEEDER

Variable speed disc feeder is driven by an electric motor. It's completely enclosed to prevent coal dust from escaping into boiler room. Volumetric design prevents moisture content of coal from disturbing accuracy. Glass door and internal illumination permit easy visual inspection of moving coal. Disc cannot be broken by tramp iron or other foreign material.

IT COSTS LESS.. TO OWN THE BEST!

KENNEDY-VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
TWO PARK AVENUE, NEW YORK
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Sunbury Plant of Pennsylvania Power & Light Co., Sunbury, Pa.

Pennsylvania Power & Light Company's

SUNBURY STATION

world's largest anthracite-fired steam electric plant, is "supported" by

GRINNELL HANGERS

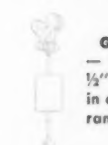
Pennsylvania Power & Light Company at its Sunbury Plant faced the problem of providing flexible, but constant support, to main steam piping carrying superheated steam under a pressure of 1350 pounds per square inch, and at a temperature of 950°F.

For "support" on that tough assignment . . . Pennsylvania Power & Light turned to Grinnell. And that is understandable. Grinnell is America's No. 1 supplier of pipe hangers and supports. Grinnell combines modern manufacturing with expert background knowledge gained during a century of piping specialization. Grinnell, and Grinnell alone, can offer these advantages:

- Complete "start to finish" production facilities — including research, design manufacturing, engineering and field service.
- Practical experience in every type of piping gained during the past 100 years.
- Coast to coast distribution — enabling "out of stock" purchases, anywhere.

Call on Grinnell . . . "whenever piping is involved."

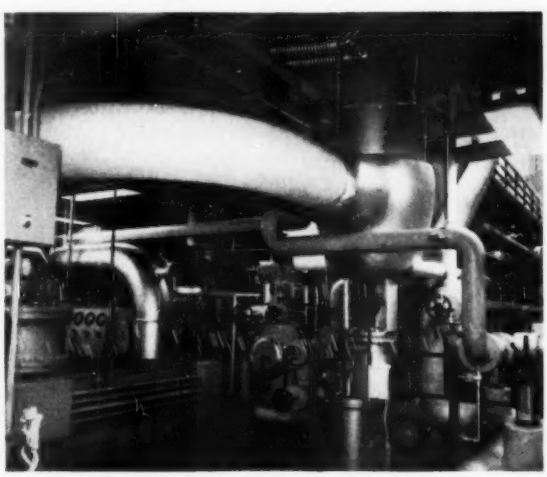
GRINNELL MODEL L CONSTANT-SUPPORTS maintain full safety factor in high temperature, high pressure systems. 3 physical structures accommodate maximum travel requirements of 2½, 5 and 10 inches; 16 sizes collectively cover numerous load ranges between 141 and 19,530 pounds.



GRINNELL PRE-ENGINEERED SPRING HANGERS — maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. 16 sizes available from stock — load range from 74 pounds to 9000 pounds.

GRINNELL VIBRATION CONTROL AND SWAY BRACES—dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 50 to 450 lbs. respectively.

Twin Grinnell Constant Support Hangers provide uniform lift for steam turbine throttle valve to prevent stresses in piping as it moves from "cold" to "hot" positions.



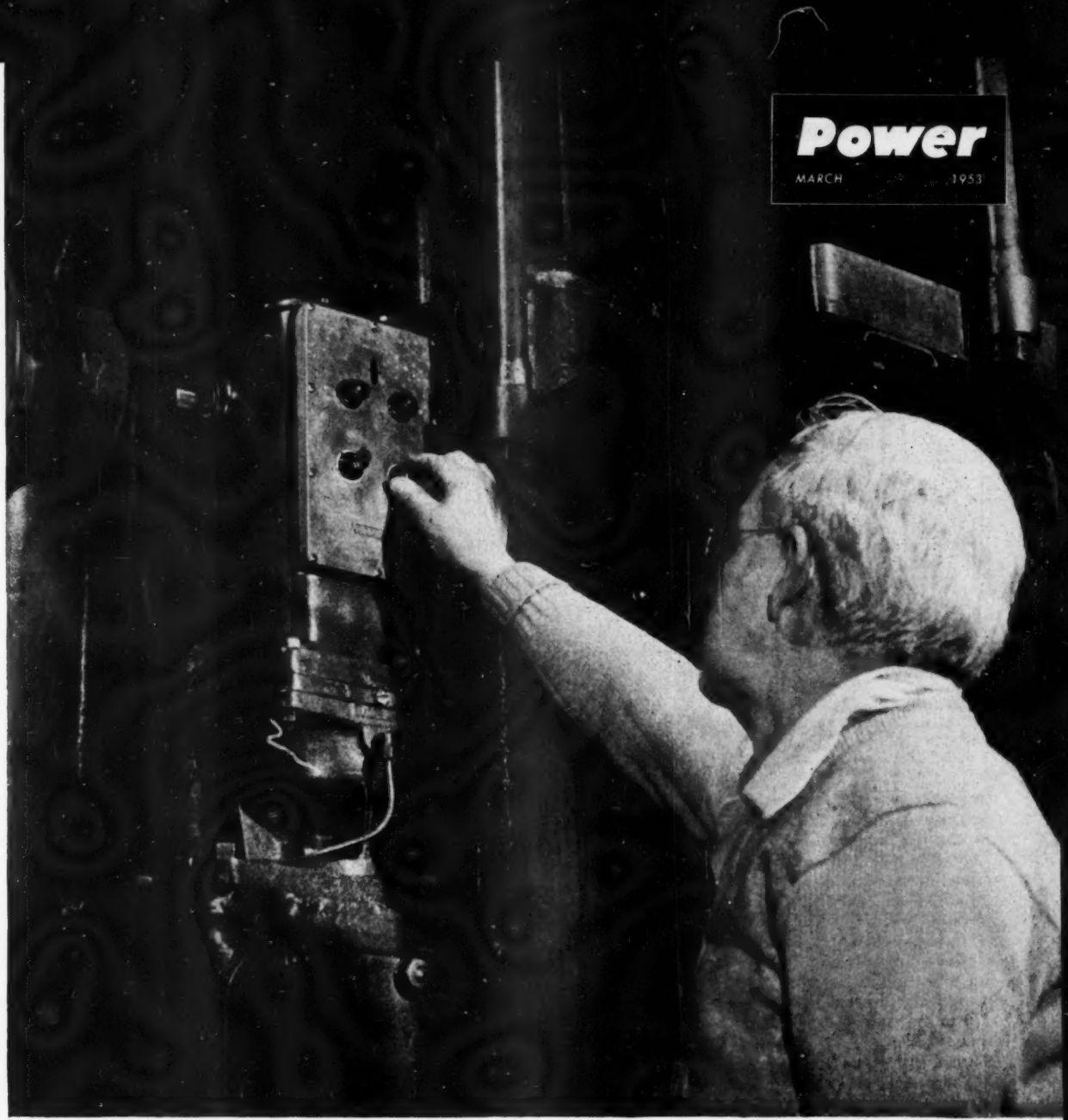
GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Power
MARCH 1953



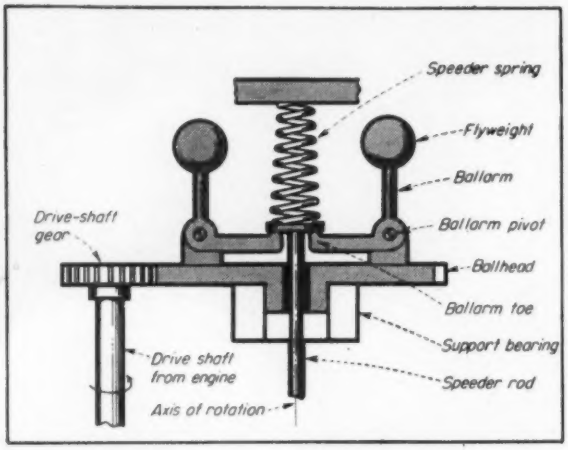
MODERN GOVERNORS assure topnotch control for internal-combustion engines operating in all types of service

DIESEL-ENGINE GOVERNORS

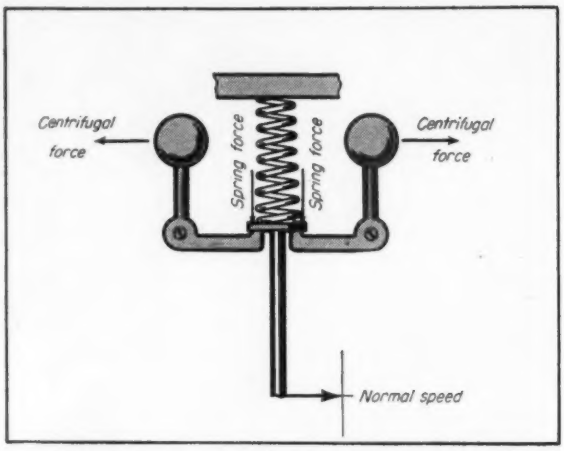
If you run a diesel plant, you'll welcome these basic facts on engine speed and load control. This article, the first in a series, takes you right to an engine's throttle to show you how governors of various types accurately regulate speed

By **EDGAR J KATES**, *Consulting Engineer, New York, N. Y.*

TURN PAGE



1 Centrifugal ballhead speed-measuring mechanism is simple, has few moving parts and accurately measures engine speed



2 Balanced position of ballheads when engine is running at normal speed. Spring force equals the centrifugal force

Governor's Heart Is the Centrifugal Ballhead That Accurately Measures

► DIESEL-ENGINE GOVERNORS are speed-sensitive devices that automatically control or limit engine speed by regulating the amount of fuel fed to the engine. Usual governor adjusts fuel-supply rate to keep engine running at steady speed regardless of load. This type is called a *speed governor*.

Governor Principles. Any change in an engine's load immediately causes an increase or decrease of engine speed. Up to an engine's capacity, power developed depends on amount of fuel burned in the cylinders. In other words, the more fuel oil or gas we inject per stroke, the more power the engine develops.

If power developed by our engine exceeds the load, this excess accelerates engine parts, causing speed to increase. When load becomes greater than power developed, the engine slows down.

An engine running with a fixed throttle (constant fuel-supply rate) speeds up when load falls off, slows down when load increases. Under some conditions the engine may "run away" if too much load is taken off, or stall if heavily overloaded.

Fuel Supply. To keep engine speed constant, just enough fuel must be supplied cylinders so power developed equals the load at desired speed. We could try to do this manually by stationing an operator at the throttle to change its setting whenever he heard engine speed change or saw the tachometer needle move. With manual control you must open throttle wider to supply more fuel to the cylinders when speed falls. Throttle is closed to reduce fuel flow when engine speed increases.

But even the most skillful operator cannot change throttle setting quickly enough to maintain a reasonably uniform speed unless load is fairly constant or changes very slowly. Function of a speed governor is to do this job rapidly, accurately and automatically. It first notes change in engine speed, then adjusts fuel admission rate to suit. We'll learn more about this later.

Flywheels. Amount an engine accelerates when power output exceeds load depends on inertia of the flywheel and other rotating parts because surplus energy is converted to kinetic energy of these parts. When load exceeds engine output the rotating parts give up kinetic energy. In both cases the flywheel reduces the amount of speed change.

Kinetic energy of a rotating part is proportional to its inertia and to the square of its rotating speed. The heavier a flywheel and the larger its diameter, the greater will be its inertia. Therefore large flywheels absorb, in kinetic energy, a given amount of surplus power with less speed increase than small flywheels. Also, there is less speed decrease when load exceeds power output. Thus larger flywheel helps engine run at a steadier speed.

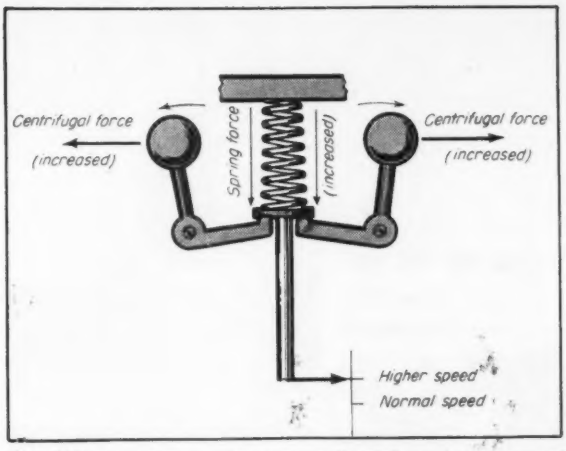
Flywheel Function. Flywheels serve two purposes: They (1) supplement governor action by preventing too much speed change during time governor is changing fuel-flow rate and cylinders start to develop needed power output (2) smooth out momentary speed changes that occur as the pistons go through their cycles of compression, expansion and exhaust. Cyclic speed variations occur because piston tends to speed up engine during firing stroke, slow it down during compression. Second function is unrelated to governor action.

Other Governors. *Constant-speed* governor described above is intended to maintain engine at a single speed from no load to full load. Other kinds of governors do different jobs, among which are:

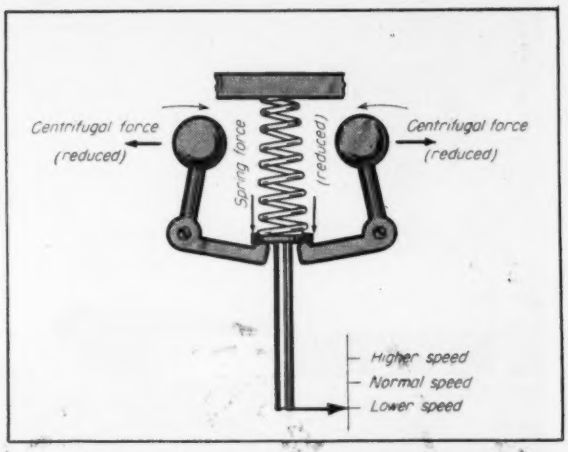
Variable-speed governor maintains any selected engine speed from idle to top speed. *Speed-limiting* governors control the engine at its maximum or minimum speed. One that holds an engine at its maximum safe speed is also called an *overspeed* governor. Note that a speed-limiting governor does not control speed when it is within the designed limit or limits.

An *overspeed trip* shuts down engine if it overspeeds. It is a safety device only.

Load-limiting governors limit the load applied to an engine at any given speed. Their purpose is to prevent overloading the engine at whatever speed it is running. *Load-control* governors control amount of load applied to the engine.



3 When engine speeds up, centrifugal force increases and the flyweights move out. Toes rise until forces balance



4 When engine slows down, the flyweights move in, lowering the ball-arm toes. Spring force falls until balance exists

The Operating Speed of a Diesel Engine

Their purpose is to adjust the load to the safe power capacity of the engine at the speed it is running.

Pressure-regulating governors used on engines driving pumps maintain a constant inlet or outlet pressure on the pump. *Torque-converter* governor controls speed of output shaft of a torque converter attached to an engine when engine runs at less than its set speed.

Speed Governors. In governing engine speed the first step is to measure it. All governors, from simplest to the most elaborate, include an accurate speed-measuring device.

Second step in governing an engine is to transfer the indication of the speed-measuring device (when a speed change occurs) into a movement of the governor's terminal or output shaft. This shaft connects to the control rod of the fuel-injection system, regulating amount of fuel injected into the engine cylinders.

Speed Measuring. In almost all diesel- and gas-engine governors, speed is measured by a centrifugal ballhead. Fig. 1. Flyweights mounted on opposite sides of a shaft are whirled by the engine through gears. These whirling weights produce a centrifugal force opposed and balanced by the speeder ring.

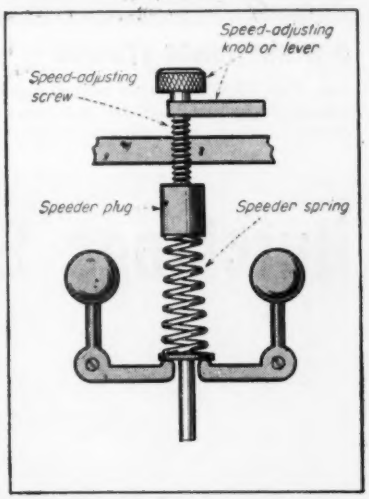
Balanced position of ballheads at normal speed is shown in Fig. 2. Note that ballarms are vertical. If engine speed increases, centrifugal force of the flyweights also increases, and they move out from their axis of rotation.

Outward movement of weights lifts the ballarm toes, increasing the opposing spring force. Since the spring is stiff compared to the centrifugal force, a balance is reached at a point where spring force equals the centrifugal force at some new position of the flyweights a little further out, Fig. 3.

Reverse action occurs if the speed falls. Flyweight centrifugal force decreases and speeder spring pushes flyweights inward until a new balance point is reached, Fig. 4. Thus, for any given speed, the flyweights assume a definite position at a certain distance from the axis of rotation.

Throttle Operation. Second step of governor action is to move engine's fuel-control mechanism. With a jerk-pump fuel-injection system, fuel-control mechanism changes pump delivery. In a common-rail type, control mechanism changes the fuel flow to the injectors. So to save words, let's use the word throttle to mean the engine's full-control mechanism, whatever its type.

Throttle Actuation. If force that moves engine throttle comes directly from the speed-measuring device, we have a *mechanical* governor. If force comes from a hydraulic pressure system controlled by the speed-measuring device, the governor is a *hydraulic* or *relay* type. In mechanical governors movement of the speeder rod itself actuates throttle linkage. In hydraulic governors, speeder rod actuates a small valve controlling a fluid under pressure; this fluid pushes on a piston or servomotor to actuate the throttle.



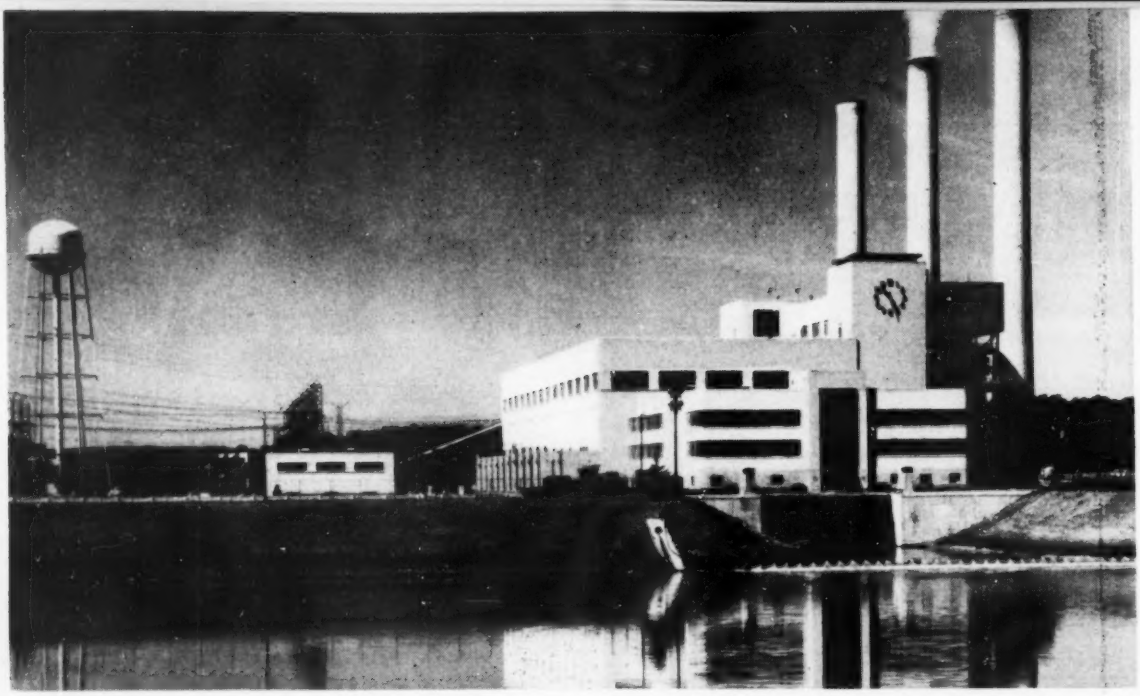
5 Adjustment for speeder-spring force is made with a knob or a small motor

Speed Adjustment. In most governors engine operator can adjust spring force that resists the centrifugal force of the flyweights. Fig. 5 shows a typical speed adjuster.

Upper end of speeder spring fits into a speeder plug that may be adjusted up or down by a knob or lever on governor's outside. Governors on engines in plants generating electric power often have the speed-adjusting screw operated by a small reversible motor controlled from the plant switchboard.

Change in speeder-spring force changes the engine's control speed by destroying the balance between ball-

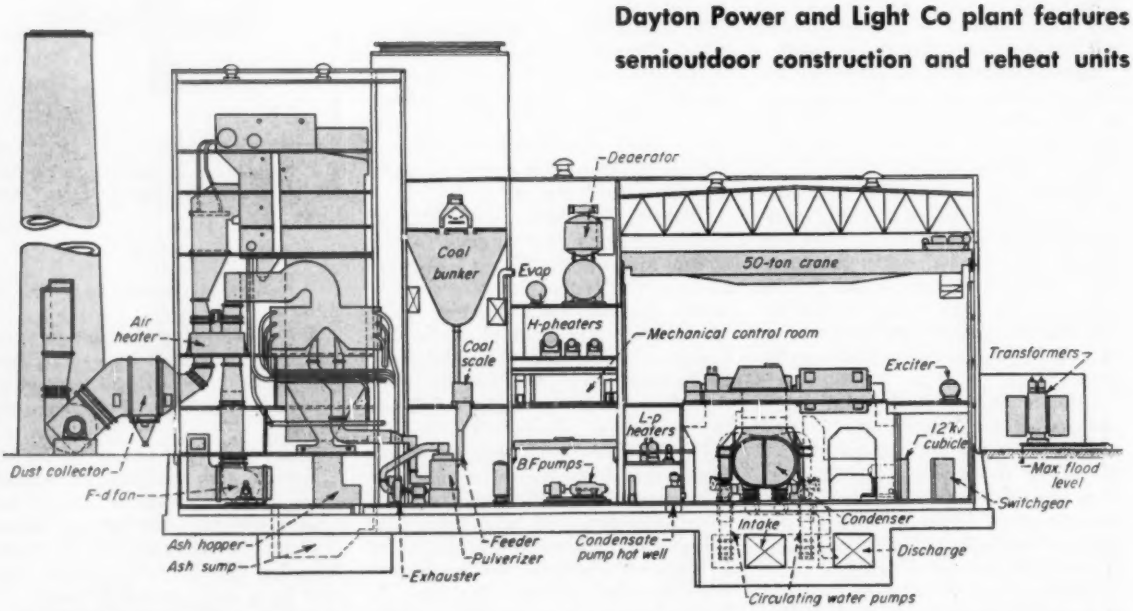
(*Continued on page* 218)



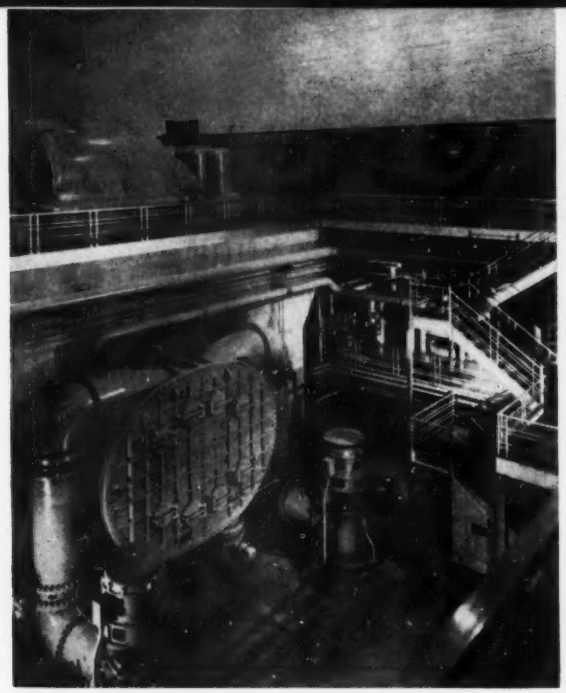
O H HUTCHINGS STATION on the Great Miami River in Ohio is 12 miles from Dayton. First 60,000-kw unit started running in July 1948. Sixth reheat unit, also 60,000-kw, will begin service this year. Semioutdoor boilers are enclosed at levels where operators must make frequent visits. Each unit is completely independent of the others up to their 69-kv bus breakers. Excepting the steam-jet air pumps, none of the auxiliaries are steam driven. A widened river channel and low-head dam form an impounding basin for supplying circulating water to the main condensers

Hutchings Station Has Conditioned Air

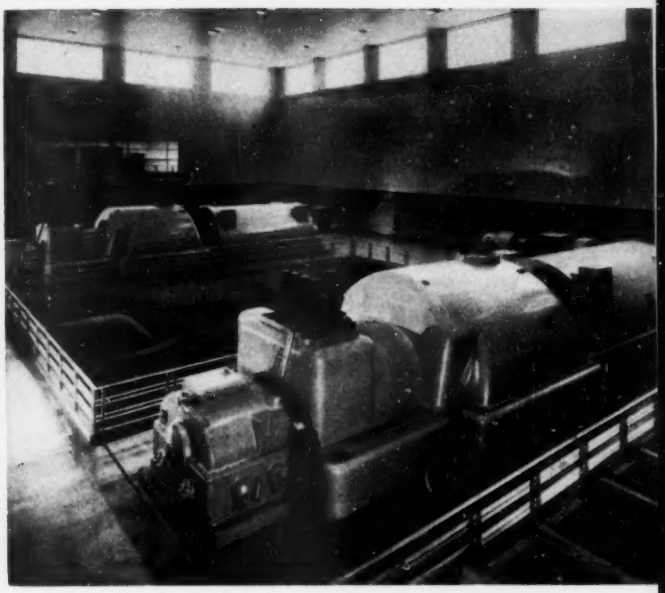
Dayton Power and Light Co plant features semioutdoor construction and reheat units



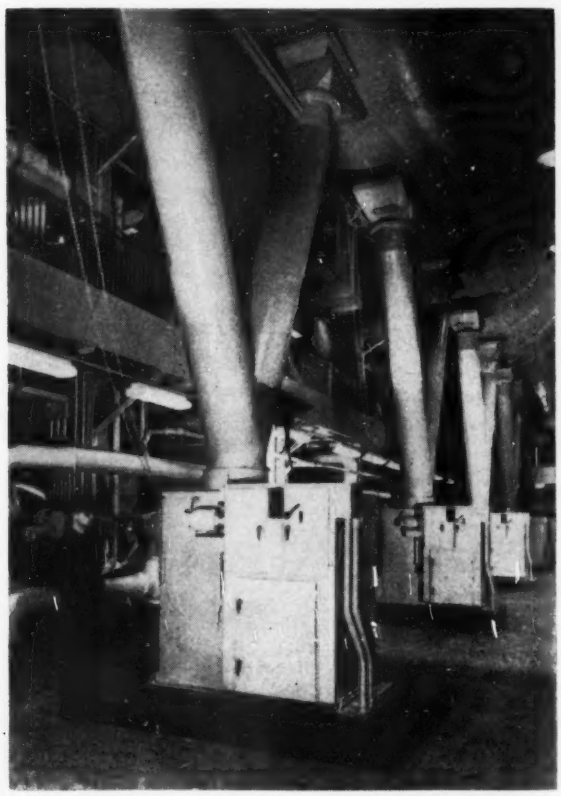
360,000-KW PLANT has two 60,000-kw straight regenerative units and four 60,000-kw reheat regenerative units. Boilers and turbines are supervised from mechanical control room on main operating floor. In addition, gage boards stand near accessory equipment throughout station. Electrical control room on third floor of building overlooks turbine room, centralizes controls for 69-kv and 2400-v circuit breakers, supervises generator loading. Centralization, automatic operation and arrangement of equipment and building materially decreases the size of the operating force needed



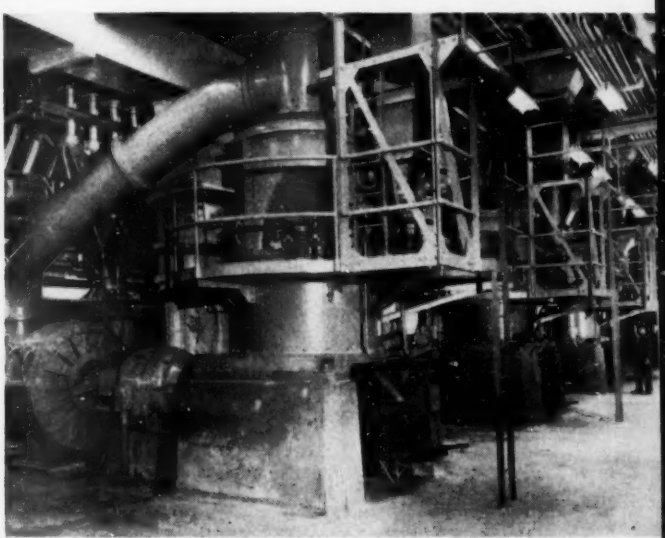
MAIN CONDENSERS of all six units are identical, have open pass through center of tube bank to transmit steam for deaerating purposes to hotwell. Condensate flows from hotwell to two cylindrical receivers, each housing one vertical 2-stage motor-driven condensate pump



UNITS NO. 1, 2 and rest of turbine room are overlooked by electrical control room. These units use 1250-psig 950-F steam and are bled at five points for feedwater heating and to supply water softener, evaporator and deaerator. Final feedwater temperature runs to 465 F.



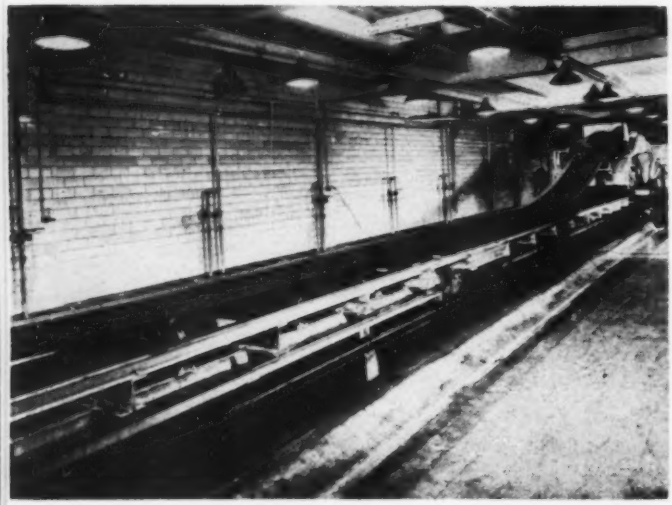
COAL SCALES receive fuel from overhead suspended unlined bunkers through horizontal rack-and-pinion type coal valves. Each boiler is served by three of these 18-ton-per-hr scales. Stainless-steel construction of weigh hoppers is expected to contribute to decreased maintenance



COAL PULVERIZERS, three for each boiler, feed total of 27 tons per hr to 12 tangential burners. They are 3-roll oil-journal type with external roll-pressure adjustments. Pulverizer foundations are integral part of building mat. Coal enters through variable-speed spider feeder

Station Designed and Erected Since the War Reflects Modern Practice, Advantages

TURN PAGE



COAL HANDLING starts with delivery by railroad cars. Yard can store 200,000 tons. Tractor pulling carryall stores and reclaims coal. Car dumper and conveyor-belt system bring coal to boiler through vibrating screen and crusher, past magnetic pulley and over tripper to bunker

CHEMICAL LABORATORY houses equipment needed for normal chemical control of station equipment and supplies. Glass block walls, holding fixed aluminum sash with clear glass, gives well-lighted work room. Forced ventilation keeps laboratory personnel comfortable

PRINCIPAL POWER-PLANT EQUIPMENT

First Installation, Units No. 1, 2

STEAM-GENERATING EQUIPMENT:

Boilers, 2 ..... Combustion Engineering-Superheater, Inc
Three-drum type, 500,000 lb per hr continuous, 550,000 lb per hr for 12 hr, 1350 psig 950-F at superheater outlet, 6600-sq-ft boiler surface, 9510-sq-ft furnace walls, 34,000-cu-ft furnace volume, 18,800 Btu per hr per cu ft heat release

Superheaters, 2 ..... Combustion Engineering-Superheater, Inc
2-stage interbank (split), pendant type, 950 F from 220,000 to 550,000 lb per hr, temperature control: primary, tilting burners, secondary bypass damper, automatic control, 16,537 sq ft

Burners, 24 ..... Combustion Engineering-Superheater, Inc
Corner mounted, tangential firing, 30-deg tilt, gas burning incl

Coal pulverizers, 6 ..... Combustion Engineering-Superheater, Inc
Bowl mills, 9 tons per hr each

Coal scales, 6 ..... Stock Equipment Co
18 tons per hr total per boiler, 400-lb hoppers

Air preheaters, 4 ..... Air Preheater Corp
Ljungstrom regenerative, 43,180 sq ft each

Forced-draft fan, 2 ..... Westinghouse Electric Corp (Sturtevant Div)
Horizontal, double inlet, inlet vanes, outlet damper, 154,000 cfm, at 80 F, 12.3 in. wg.

F-d fan drives, 2 ..... Allis-Chalmers Mfg Co
400-hp 2300-v constant-speed ac motors

Induced-draft fans, 2 ..... Westinghouse Electric Corp (Sturtevant Div)
Horizontal, double inlet, hydraulic coupling, inlet damper, 267,000 cfm at 308 F, 19.86 in. wg

I-d fan drives, 2 ..... Allis-Chalmers Mfg Co
1200-hp, 2300-v constant-speed ac motors

Stack, 1 ..... Rust Engineering Co
Inner-stack red brick, 14x250 ft, outer-stack radial brick, same height. Air admitted at ground level to space between stacks. Double cap with air sweeping over cap of outer stack. Stack serves two boilers. Ash removed by hydrovactor

Soot blowers ..... Diamond Power Specialty Corp
Automatic, sequential, air puff, 22 fixed units, four continuous-blow retractable units, 300 psig

Dust collector ..... Aerotec Corp

POWER-GENERATING EQUIPMENT:

Turbine-generators, 2 ..... General Electric Co
Tandem compound, 21-stage, 60,000 kw, 1250 psig, 950 F, 1.5-in. Hg abs, 5 bleed points, 3600 rpm, 70,588-kva generator, 12,500 v, 60 cycle, 3 phase, hydrogen cooled

Exciters, 2 ..... General Electric Co
200 kw, 250 v, 1200 rpm shunt wound, driven by 300-hp 2300-v motor

Condenser, 2 ..... Allis-Chalmers Mfg Co
45,000 sq ft, 2-pass, horizontal, water inlet at top, admiralty tubes

Air ejector, 1 ..... Allis-Chalmers Mfg Co
Steam jet, 2-stage, twin element, intercooler, aftercooler

CONDENSATE AND FEEDWATER SYSTEM:

Condensate pumps, 2 ..... Allis-Chalmers Mfg Co
Vertical, 2-stage, single suction, 875 gpm, 250-ft total head, 1170 rpm, 100-hp 440-v motor drive

Circulating pumps, 2 ..... Allis-Chalmers Mfg Co
Vertical, 21,600 gpm each

Boiler feed pumps, 3 ..... Allis-Chalmers Mfg Co
7-stage, centrifugal, 1190 gpm, 4250 ft tdh, 3580 rpm, automatic by-pass; 2000-hp 2300-v constant-speed motor drive

Feed pump bypass controls, 3 ..... Bailey Meter Co

Closed feedwater heaters, 10 ..... Griscom Russell Co
U-tube, horizontal; 3rd-stage: 2807 sq ft, No. 15 gage, 70-30 cu-ni; 7th stage: 1470 sq ft, No. 15 gage, 70-30 cu-ni; 10th stage: 1470 sq ft, No. 15 gage, 70-30 cu-ni; 15th stage: 1647 sq ft, No. 18 gage, arsenical copper; 18th stage: 2130 sq ft, No. 18 gage arsenical copper

Deaerator, 2 ..... Worthington Corp
640,000 lb per hr, double shell, steam jet, 52 psig, 2850 cu ft

Drain controls ..... Fisher Governor Co

Heater drain pumps, 4 ..... Worthington Corp
L-p: 2-stage, 1800 rpm, 200 gpm, 259 ft tdh. H-p: 3550 rpm, 100 gpm, 88 ft tdh

Heater pump drives, 4 ..... Allis-Chalmers Mfg Co
L-p: 25-hp 440-v motors. H-p: 5-hp 440-v motors

Evaporator, 2 ..... Griscom-Russell Co
Horizontal, bent tube, 18,000-lb per hr

Water softener, 2 ..... Worthington Corp
Hot-process lime and soda

ACCESSORY EQUIPMENT:

Ash sluice systems ..... Allen-Sherman-Hoff Co
Two ash-transfer pumps, 1100 gpm, one bilge pump, 1100 gpm, one hydrovactor, 150 psig supply

Ash sluice pumps, 1500 gpm, 2 ..... Allis-Chalmers Mfg Co
1500 gpm, 250-ft tdh, 1760 rpm, 150-hp 2300-v motor drive

Screen-washing pumps, 2 ..... Allis-Chalmers Mfg Co

Service water and fire pump, 1 ..... Allis-Chalmers Mfg Co
1000 gpm, 246-ft tdh, 1750 rpm

Evaporator feed pumps, 150-ft tdh, 2 ..... Ingersoll-Rand Co

Evaporator feed pump drives, 2 ..... Allis-Chalmers Mfg Co
5-hp 440-v 3450-rpm motors

Chemical feed pumps, 2 ..... Milton Roy Co

Station air compressor ..... Worthington Corp
Vertical angle, double acting, 2-stage, intercooler, aftercooler, 3-step capacity control, 100 psig, 541-cfm free air

Soot-blowing air compressors, 2 ..... Worthington Corp
Horizontal, duplex, 2-stage, water cooled, dual control, 500 psig, 552 cfm free air; 200-hp 2300-v motor drive

Control air compressors, 2 ..... Ingersoll-Rand Co
Horizontal, straight line, single stage

Sump pumps ..... Yeomans Brothers Co

Piping ..... Pittsburgh Piping and Equipment Co
Chrome-molybdenum for h-p lines, normal carbon steel for l-p lines

Cast-steel valves ..... Wm Powell Co

Combustion and superheat control ..... Leeds & Northrup Co

Feedwater control, 3-element ..... Bailey Meter Co

Flowmeters, pressure recorders ..... Bailey Meter Co

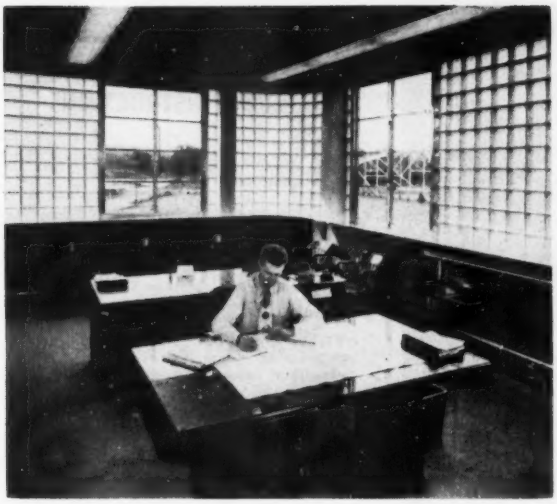
Temperature, conductivity recorders ..... Leeds & Northrup Co

Liquid-level recorders ..... Bailey Meter Co

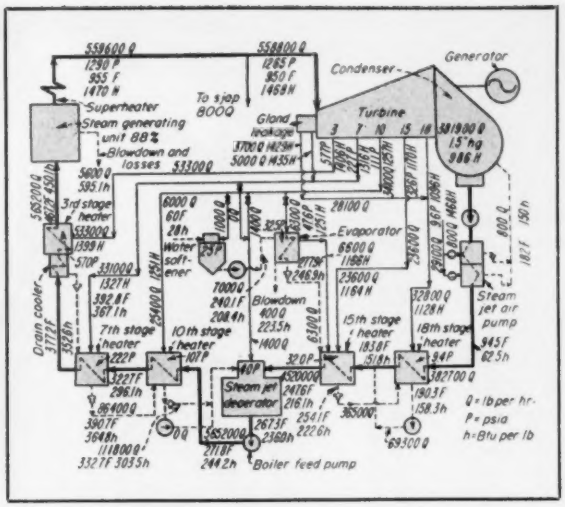
Liquid-level indicators ..... Yarnall-Waring Co

ELECTRICAL EQUIPMENT:

Transformers, main, 6 ..... Westinghouse Electric Corp
21,667 kva, 69,000/12,000-v oil-filled, self-cooled, single phase



STATION MANAGER, Arthur A Hanson, occupies air-conditioned "daylighted" office that would be envied by many executives. Glass block paneling is used in many places around the plant. It contributes attractively to architectural treatment, while brightening the interior area



HEAT BALANCE AT FULL LOAD on first two units predicts gross generation of 62,500 kw and net output of 57,970 kw. Over-all station heat rate figures at 11,200 Btu per kwhr, net. Five bleed points feed six heaters, deaerating pressure being throttled

O H Hutchings Station, Dayton Power and Light Co

Station auxiliary transformer, 1 ..... Westinghouse Electric Corp
7500 kva, 69,000/2400-v oil filled, self cooled, 3-phase
Unit auxiliary transformers, 2 ..... Westinghouse Electric Corp
6000 kva, 12,000/2400-v oil filled, self cooled, 3-phase
Auxiliary transformers, 2 ..... Wagner Electric Corp
750 kva, 2400/440 v
69,000-v and 2400-v switchgear ..... Westinghouse Electric Corp
440-v switchgear ..... ITE Circuit Breaker Co
Main electrical switchboard ..... Westinghouse Electric Corp
Batteries, 60-cell, 2 ..... Electric Storage Battery Co
Control transformers, 3 ..... Wagner Electric Corp

MISCELLANEOUS EQUIPMENT:

Car dumper, 100 ton, 20 cars per hr ..... Link-Belt Co
Coal crusher, 350 tph ..... American Pulverizer Co
Traveling screens, 2 ..... Chain Belt Co
Two screens in series, 1st ⅜-in. mesh, 2nd ¼-in. mesh
Chlorination system ..... Wallace and Tiernan Co

Units 3, 4 (No. 5, 6 Essentially Similar)

STEAM-GENERATING EQUIPMENT:

Boilers, 2 ..... Combustion Engineering-Superheater, Inc
3-drum type, 430,000 lb per hr continuous, 1500 psig at superheater outlet, 1670 psig design, 20,745 sq ft furnace heating surface, 30,400 cu ft furnace volume
Superheaters, 2 ..... Combustion Engineering-Superheater, Inc
2-stage interbank (split) pendant type, 1000 F from 300,000 to 430,000 lb per hr, automatically controlled desuperheating spray, 31,000 sq ft heating surface
Reheaters, 2 ..... Combustion Engineering-Superheater, Inc
Interstage type, 687-F inlet, 1000-F outlet from 270,000 to 385,000 lb per hr. Temperature control—primary: tilting burners; secondary: automatic desuperheating spray, 7100 sq ft heating surface
Burners, 24 ..... Combustion Engineering-Superheater, Inc
Tilting, corner mounted, tangential firing, gas-burning future
Coal pulverizers, 6 ..... Combustion Engineering-Superheater, Inc
Bowl mills, 9 tph each
Coal scales, 6 ..... Stock Equipment Co
18 tph, 400-lb hoppers
Air preheaters, 4 ..... Air Preheater Corp
Ljungstrom regenerative type, 46,600 sq ft each
Forced-draft fans, 2 ..... Westinghouse Electric Corp (Sturtevant Div)
Horizontal, double inlet, inlet vanes, outlet dampers, 160,000 cfm at 100 F, 14.1 in. wg
F-d fan drives, 2 ..... Allis-Chalmers Mfg Co
500 hp, 2300-v constant-speed motors
Induced-draft fans, 2 ..... Westinghouse Electric Corp (Sturtevant Div)
Horizontal, double inlet, magnetic coupling, inlet damper, 259,000 cfm at 305 F and 16.6 in. wg
I-d fan drives, 2 ..... Allis-Chalmers Mfg Co
1000-hp 2300-v 705-rpm constant-speed motor
Stack, 1 ..... Rust Engineering Co
Same as first stack
Soot blowers ..... Diamond Power Specialty Corp
Automatic sequential control, 12 long retractable blowers, 8 short retractable wall blowers
Dust collector ..... Aerotec Corp

POWER-GENERATING EQUIPMENT:

Turbines, 2 ..... General Electric Co
Tandem compound, 23 stage, 1450 psig, 1000/1000-F reheat, 1.5 in. Hg abs, six bleed points, 60,000 kw
Generators, 2 ..... General Electric Co
70,588 kva, 3600 rpm, 12,500 v, 60 cycle, 3-phase, hydrogen cooled, 5 to 15 psig H₂ pressure
Exciter ..... General Electric Co
1200 rpm, 200 kw, 250 v; 300-hp 2300-v motor drive
Condensers, 2 (same as Units 1, 2) ..... Allis-Chalmers Mfg Co
Air ejectors, 2, (same as Units 1, 2) ..... Allis-Chalmers Mfg Co

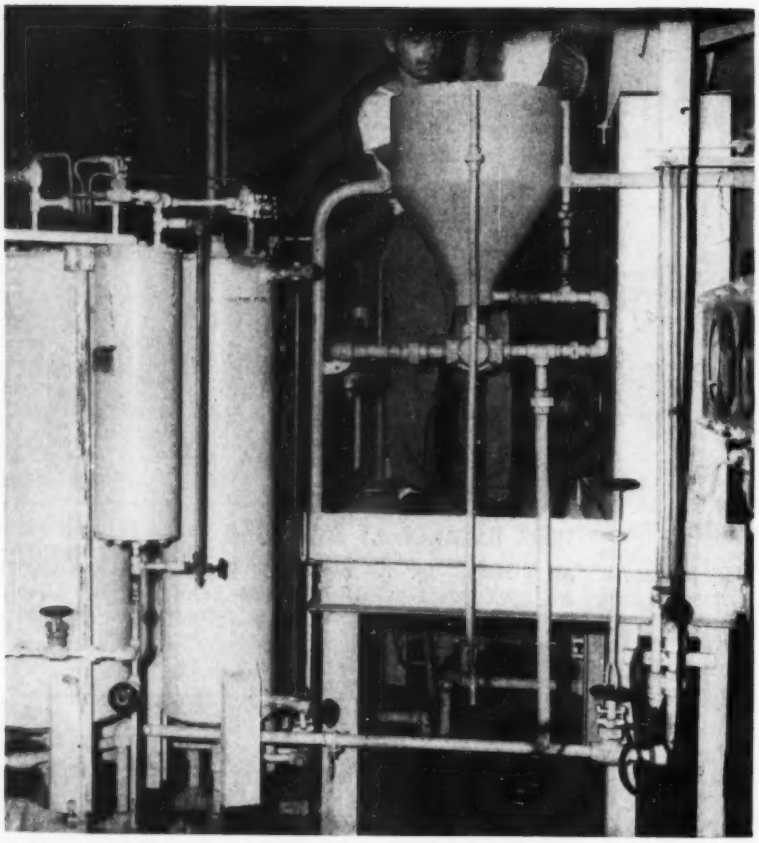
CONDENSATE AND FEEDWATER SYSTEM:

Condensate pumps, 2 ..... Allis-Chalmers Mfg Co
Vertical, 2-stage, single suction, 675 gpm, 350 ft tdh, 1760 rpm; 125-hp 440-v motor drive
Circulating pumps, 2 ..... Allis-Chalmers Mfg Co
Vertical, 21,650 gpm, 27.5-ft tdh, 585 rpm; 250-hp 2300-v motor drive
Boiler feed pumps, 3 ..... Allis-Chalmers Mfg Co
7 stage, 1100 gpm, 4370-ft total head, 3575 rpm, automatic bypass; 1750-hp 2300-v constant-speed motor drive
Feed pumps bypass controls, 3 ..... Bailey Meter Co
Feedwater heaters, 10 ..... Griscom-Russell Co
Horizontal U-tube; crossover: No. 14 BWG 70-30 cu-ni tubes, 2485 sq ft; 11th stage: No. 14 BWG 70-30 cu-ni tubes, 1360 sq ft; 13th stage: No. 14 BWG 70-30 cu-ni tubes, 948 sq ft; 19th stage: No. 18 BWG, arsenical copper tubes, 1152 sq ft; 21st stage: No. 18 BWG arsenical copper tubes, 1342 sq ft
H-p heater drain pumps, 4 ..... Allis-Chalmers Mfg Co
180 gpm, 75-ft tdh, 1160 rpm; 7.5-hp 440-v motor drive
L-p heater drain pumps, 4 ..... Allis-Chalmers Mfg Co
100 gpm, 379-ft tdh, 3550 rpm; 25-hp 440-v motor drive
Deaerators, 2 ..... Worthington Corp
475,000 lb per hr, double shell, steam-jet type, 59 psig, storage tank 12,850 cu ft
Evaporator, 1 ..... Griscom-Russell Co
Horizontal, bent-tube, 15,500 lb per hr
Soot-blowing air compressor, 1 ..... Worthington Corp
Vertical angle, 3-stage, water-cooled, 536 cfm free air, 500 psig; 200-hp 2300-v motor drive
Control air compressor, 1 (similar to Unit 1) ..... Ingersoll-Rand Co

ELECTRIC EQUIPMENT:

Main transformers, 3 ..... Westinghouse Electric Corp
21,667 kva, 69,000/12,000 v, oil filled, forced-air cooled, single phase
Main transformer, 1 ..... Westinghouse Electric Corp
60,000/75,000 kva, 69,000/12,000-v, oil filled, forced-air cooled, 3-phase
Unit auxiliary transformers, 2 ..... Westinghouse Electric Corp
4500 kva, 3 phase, oil filled, self cooled, 12,000/2400 v
Distribution transformers, 2 ..... Wagner Electric Corp
750 kva, 2400/480 v, three phase, dry type
Switch gear ..... ITE Circuit Breaker Co

CONSULTING ENGINEERS ..... Ebasco Services Inc



SINGLE CHEMICAL-DISSOLVING TANK serves a battery of separate storage tanks, Fig. 1 and 2. It gives a relatively small design, lets you use stainless metals

CHEMICAL FEED TANK CHARGING INSTRUCTIONS

- Weigh out the required chemical charge in bucket provided
- Open necessary vent valves to atmosphere. Open drain valve on bottom of tank to be charged. Flush same by opening proper manifold valve to that tank, placing directing valve in second position (handle vertical), Fig. 2
- After flushing, close manifold valve, restore directing valve to first position (handle horizontal). Fill funnel to 6-in. depth by using "rinse-ring" valve. Then close this valve
- Open the dissolving-water stop valve wide. As water rotates in funnel gradually sift the feed chemical into funnel in such a way as to have it all in just before water reaches the overflow pipe
- Close dissolving-water stop valve, open proper manifold valve to tank to be charged, allow solution to drain into tank. When funnel is empty, flush by briefly opening "rinse-water" stop valve to clean funnel of chemical.
- Complete filling the tank by placing the directing valve in second position (handle vertical). When tank is full, close manifold valve
- Open manifold drain valve a few seconds to flush line, then close. Restore directing valve to first position (handle horizontal)
- Reset vent valves when necessary (evaporator feed, sulfite tanks) to draw from bubbler tank
- When not in use, all chemical charging valves shall be in the closed position

Troublefree Chemical Feed System

Seemingly simple job of dissolving and feeding chemicals into a boiler-water cycle raises problems all its own. Here's a sure method that's proved fully reliable over a 5-year period in a large-scale central station plant out in California

By R C ALEXANDER
Mechanical Engineer
Department of Water & Power
Los Angeles, Calif.

► SO MANY POWER PLANTS across the country use roughly the same chemicals for water treatment that you'd expect some general agreement on what's good equipment for feeding these chemicals into the boiler cycle. But actually you'll find anything but agreement. In many instances this seemingly simple process proves a source of operating troubles.

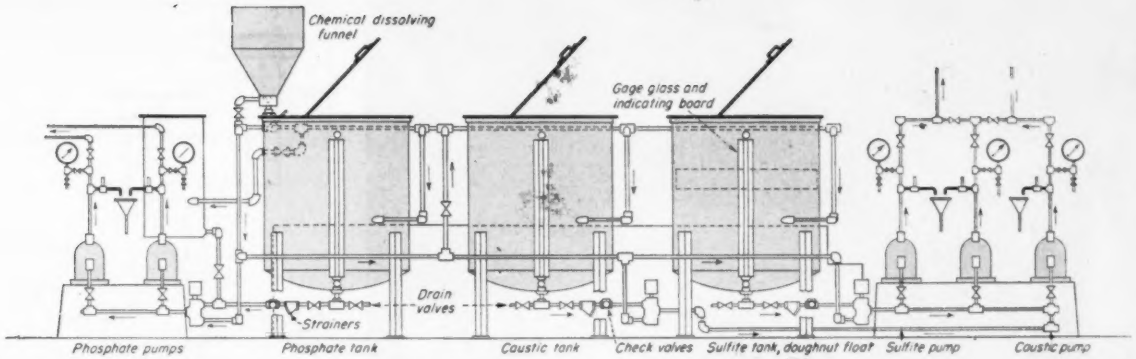
The more important phases of the chemical-feeding problem fall into three divisions: (1) pickup of unwanted outside air (2) handling of sticky, intermediary pastes (3) removal of undesirable insolubles in commercial grades of chemicals as supplied.

Outside Air. In dissolving a solid salt like sodium sulfite it is essential to complete the solution as quickly as possible with as little air pickup as possible. The longer the time, the more outside air reaction takes place. Then the chemical has less working capacity to deliver where you want it most—in the feedwater. The newly developed catalyzed sulfites have greatly accelerated oxidation rates so time and aeration factors are of even greater consequence.

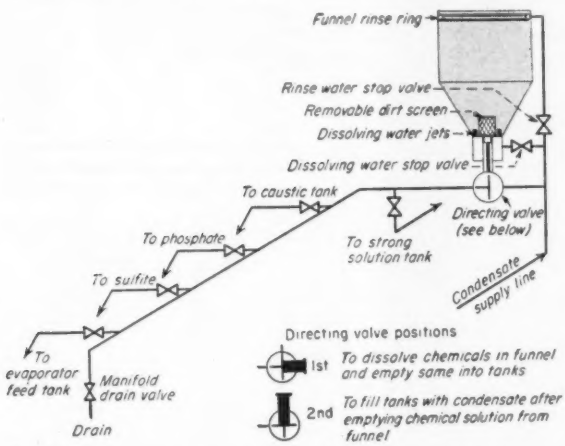
Sticky Pastes. Certain other chemicals, like finely powdered anhydrous disodium phosphate, form sticky, hard-to-dissolve pastes that require vigorous mechanical agitation.

Undesirable Insolubles. Industrial or commercial-grade chemicals ordinarily contain a small percentage of insolubles that should be screened out to protect chemical feed pumps, check valves, lines, control valves.

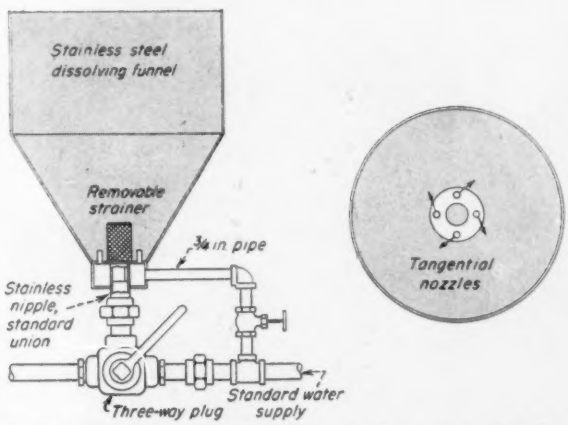
Each and every one of these difficulties can be solved by proper design. What's more, the overriding headache of corrosion to chemical feeder parts can also be reduced or controlled entirely at the design stage. It's always an interesting point for the average operator to realize sodium sulfite, commonly used to prevent oxidation corrosion in boil-



1 This complete piping and physical layout of a working chemical-feeding design indicates how the low-head bottom-discharge dissolver in the photo on facing page fits smoothly into the simplified flow procedure pictured below in Fig. 2



2 Schematic arrangement of dissolver and storage-tank portrays the role of manifold in simplifying design layout



3 Various parts making up bottom-feed discharge dissolver have standard dimensions, use stainless steel where needed

Results From an Integrated Design

ers, causes severe corrosion of the steel mixing tanks.

Ideal approach to meeting all these problems is to design for separate storage tanks for the different chemicals you'll use. Then put in a piping manifold, Fig. 2, to a single dissolver. This allows you to hold the dissolver design relatively small, and hence use stainless metals in corrosive areas.

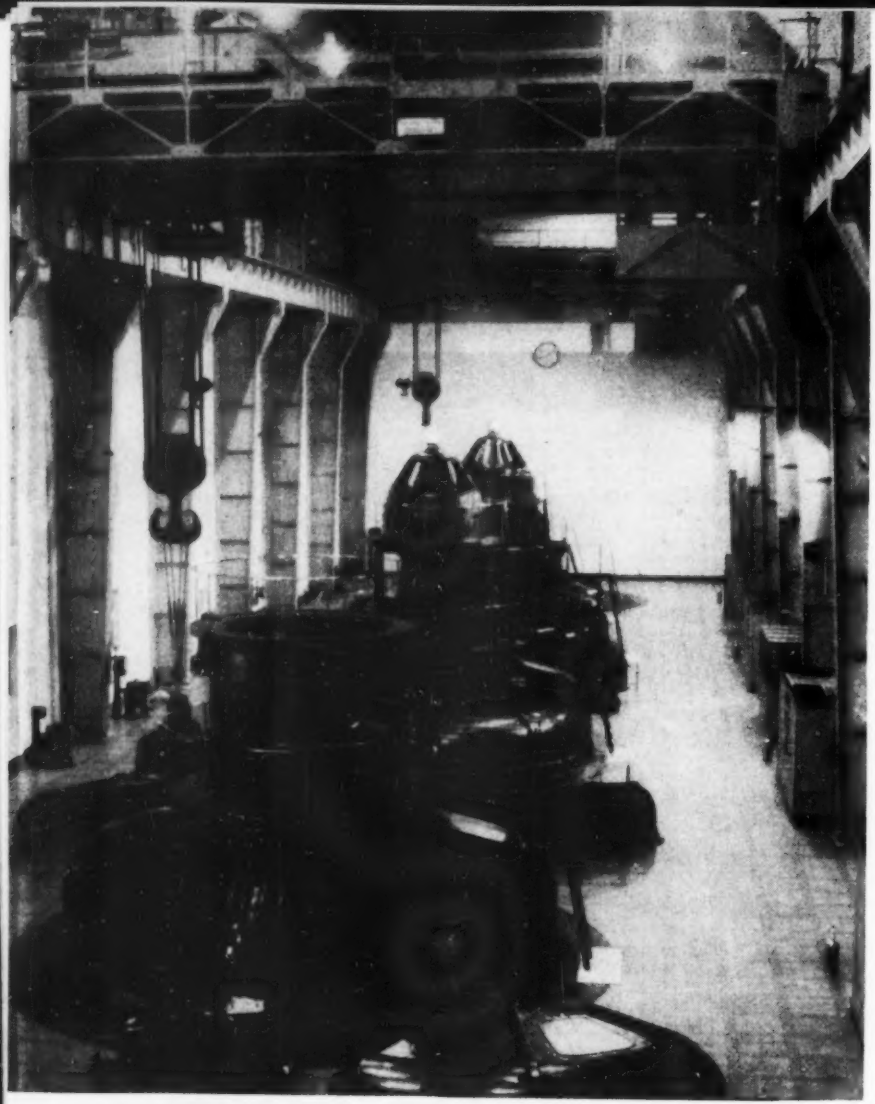
Such an interconnecting system, though, requires adequate flushing facilities. This alone insures freedom from any contamination of later solutions by traces of previously mixed chemicals.

Screening, in the order of 60 mesh or finer, can be installed on the dissolver tank, Fig. 3, to prevent undesirable insolubles. It should be removable and easily seen by the operator so he can clean it as often as needed. Experience shows stainless-steel screening, silver-soldered in place, gives best results. Ultimate aim of the dissolver is to supply a solution carrying the correct weight of chemicals, completely mixed throughout, with no stratification and as free of contaminants as possible.

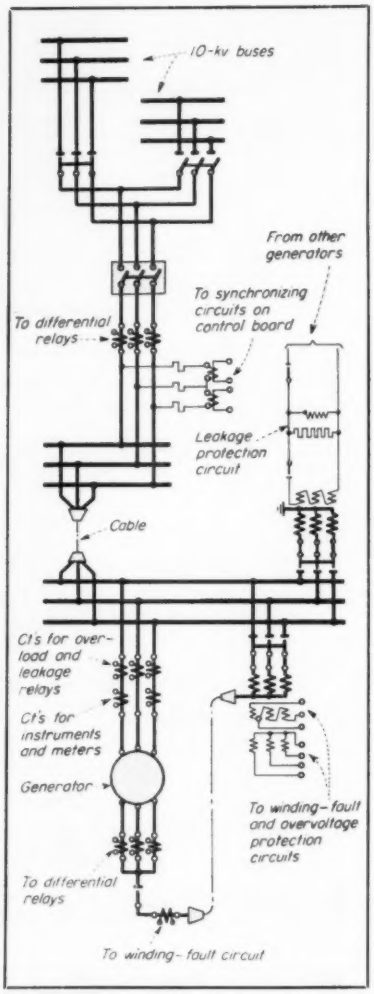
Working System. Illustrations on these pages show a chemical storage and dissolving system in service at the Harbor Steam Plant, Unit No. 2, that has hung up a completely satisfactory 5-yr record. It involves chemical mixing and feedings, and handles sodium hydroxide, sodium sulfite, disodium phosphate, strong solutions for boiler and feedwater treatment and mixed chemicals for evaporator liquor treatment. Fig. 2 shows the essentials of the system, its special dissolving funnel and the various storage-tank manifold piping.

The funnel, Fig. 2, 3, is built above an annular chamber, which houses four tangent nozzles, right, Fig. 3. Water enters this chamber from the nozzles and gives a vigorous swirling motion to the liquid as the funnel fills. When this swirling liquid reaches a suitable height in the funnel, the dry chemical is added at a high rate. There is little tendency for the chemical to agglomerate into a paste since the hydraulic shear forces break up the chemical. In fact, we've run tests where we've fed as high as 5 lb of fine powdered anhydrous sodium sulfite, in mass, and found it completely dissolved by the time the funnel was full.

Once the dissolving is complete we open the proper tank valve and let the solution drain by gravity from the dissolver into that tank. Then we bring water through the funnel rinse-ring to thoroughly clean all parts of any adherent solution. This rinse water flows out through the gravity feed line into the storage tank so the manifold is also thoroughly flushed. In addition a drain, fitting to the sewer, ties in at the end of the manifold so the flushing can be carried out for the full manifold length when so desired.



MAJOR OVERHAUL for each machine comes once every 4-7 years. Unit is completely disassembled and all worn parts renewed. Generator is dried out after reassembly



RELAY CIRCUITS kept intact during tests except for insertion of test instruments

Electrical Test Program Holds Down Hydro-Plant Outages

With reserve capacity in Ireland's Ardnacrusha Hydro Station cut to bare minimum during last war, maintenance assumed major importance. Here is the electrical side of their successful maintenance plan covering 115,000 kva of generating capacity

By **P BYRNE**, *Engineer, Ardnacrusha Hydro Station, Ireland*

► THE SHANNON RIVER winds through 230 miles in South Ireland before spilling into the sea. During its travel it flows through three lakes and has a total fall of 300 ft. Ardnacrusha Hydro Station, powered by the Shannon, is equipped with four generators having a combined rating of 115,000 kva. Major section of the plant went into operation in 1929. By 1939 when World War II started, much of the equipment needed some major maintenance.

Largest job to date has been the complete rebuilding of three generator stators. A serious increase in core heating over the years made this necessary. Before the war, equipment manufacturers offered advice plus use of laboratories and work shops on major maintenance jobs. In fact, they were handling the entire work on most of the larger jobs dealing with generating equipment.

Three Degrees of Generator Maintenance in Ardnacrusha Station

Generator	Monthly Check	Annual Overhaul	Major Overhaul—Every 4-7 Years
Slip rings	Cleaned; polarity reversed if required	Cleaned; turned down if required	Turned down, or replaced if required
Brush gear	Cleaned; worn brushes replaced	Cleaned and adjusted; worn brushes replaced	Cleaned and adjusted; worn brushes replaced
Rotor	Tested with megohmmeter	Cleaned where possible, but not removed. Tested with megohmmeter	Removed and cleaned. Pole bolts tested for permanent set and for tightness. Pole windings reclamped if protruding mica shows looseness between turns
Stator	Not attended to	Cleaned where possible. Tested with megohmmeter. Both bindings and wedges inspected	Air passages cleared. Loose bindings made good; end connections varnished. Check d for coil deformation or displacement, for wedge slip. Laminations' condition examined as far as possible. Core bolts tightened if necessary.

But the war changed this picture. Station personnel were thrown on their own for major repairs. And further problems were presented. For instance, station reserve capacity was reduced from norm of about 20,000 kw to essentially zero at certain times of the day. This meant allowable time for maintenance was generally channeled into periods outside normal working hours: evenings and early mornings.

Maintenance Objectives. Before looking into the specific plan used at Ardnacrusha, let us consider maintenance in general. Normally, maintenance is a plan for preserving plant and structure in efficient working condition. But with the shortage of reserve generating capacity we faced, aims took on a slightly different hue. In brief, quality of maintenance had to be upped to the point where incipient faults were located by inspection or test. A large proportion of probable faults just had to be anticipated.

To illustrate, let's consider a single generator. It is equipped with protective devices to prevent or limit fault damage. But even though these protective relays perform their design function the system is temporarily short-handed, capacity-wise, by the unit being tripped off the line. To prevent this we made an all-out effort to detect faults in their embryonic stage. And the results were good. Yardstick was the comparative freedom from serious power interruptions over the past years, even in the face of an increased number of faults.

These faults varied from a low of 15 in 1944 to a peak of 61 in 1949. Potential trouble sources, even though detected before failure occurred, are listed here as faults. Typical faults were lightning damage to station bus, punctured transformer bushing, failure of 110-kv insulators, water (5 gal) in tank of 110-kv ocb, relay defects spotted during overhaul.

Maintenance Plan. Extended maintenance could be carried out only during period from April to September, when water inflow normally dropped. And even during this season only one of the four units could be taken out of service. Other times available for work, without wasting water or losing load, were weekends or early morning hours. So to meet this double need—maximum availability and maximum reliability—the following maintenance plan was evolved for the four main generating units.

Monthly checks consisting of a mechanical and electrical once-over, take between 6 and 8 hr. In addition each unit receives an annual *general overhaul*. This includes a detailed inspection for wear, thorough cleaning of exciter, purification of lubricating and servomotor oils, cleaning of generator stator, plus a general electrical checkup. It does not include general disassembly of parts. This overhaul takes about 14 days.

Major overhaul for each machine comes once every 4 to 7 years. Unit is completely disassembled and all worn parts renewed. After reassembly the generator is dried out. This work takes 3 to 4 months.

Electrical Tests. At one time, instruments and protective relays were taken down and sent to a central point for bench testing while the machine was being overhauled. But we ran into some difficulties. For instance, delicate relays and instruments, having been tested in the central lab, were occasionally damaged during transportation or reinstallation. And since they received no further check the damage sometimes passed unnoticed till the relay was called on to operate.

Furthermore, taking relays down and reinstalling after testing opened up possibility of mistakes in reconnecting. Relays that are gravity controlled may be tested in one position and installed in another, affecting operation.

These problems were neatly sidestepped by testing all relays in position

with wiring complete as far as possible. Test power is applied to the primary of instrument transformers. Faults, likely to occur in practice, are simulated.

Preliminary testing includes an insulation check on all low-voltage wiring; 1000 v, 50 cycles for 1 min. Then all voltage and current transformers, shunts, instruments and relays are tested over their working range.

Following six main tests are then run with all relay and instrument circuits intact except for temporary connection of substandard instruments like voltmeters and ammeters:

1. Open circuit test on alternator is run with machine at normal speed, no load, and excited from zero to full voltage. Generator voltage is measured on a test instrument and plotted against excitation current. No-load voltage curve results. This curve is compared with that taken at time unit first went into service. During the test, voltmeters on stator and exciter panels are checked with the test instruments.

Overvoltage relay is adjusted for a moderate overvoltage. Excitation is increased until relay trips. Tripping voltage is noted and compared with relay setting. Panel frequency meter is next checked against a test instrument. Generator speed is varied from —5% to +5% of normal.

2. Ground test calls for generator running at normal speed with one stator-winding terminal connected to ground inside all current transformers. Generator is excited and voltage raised until ground relays operate. Excitation value at this point is noted. Then from no-load curve, generator emf at tripping can be determined. For fair protection, this value should not exceed 10% of normal voltage. In other words, 90% of the winding should be protected against ground faults.

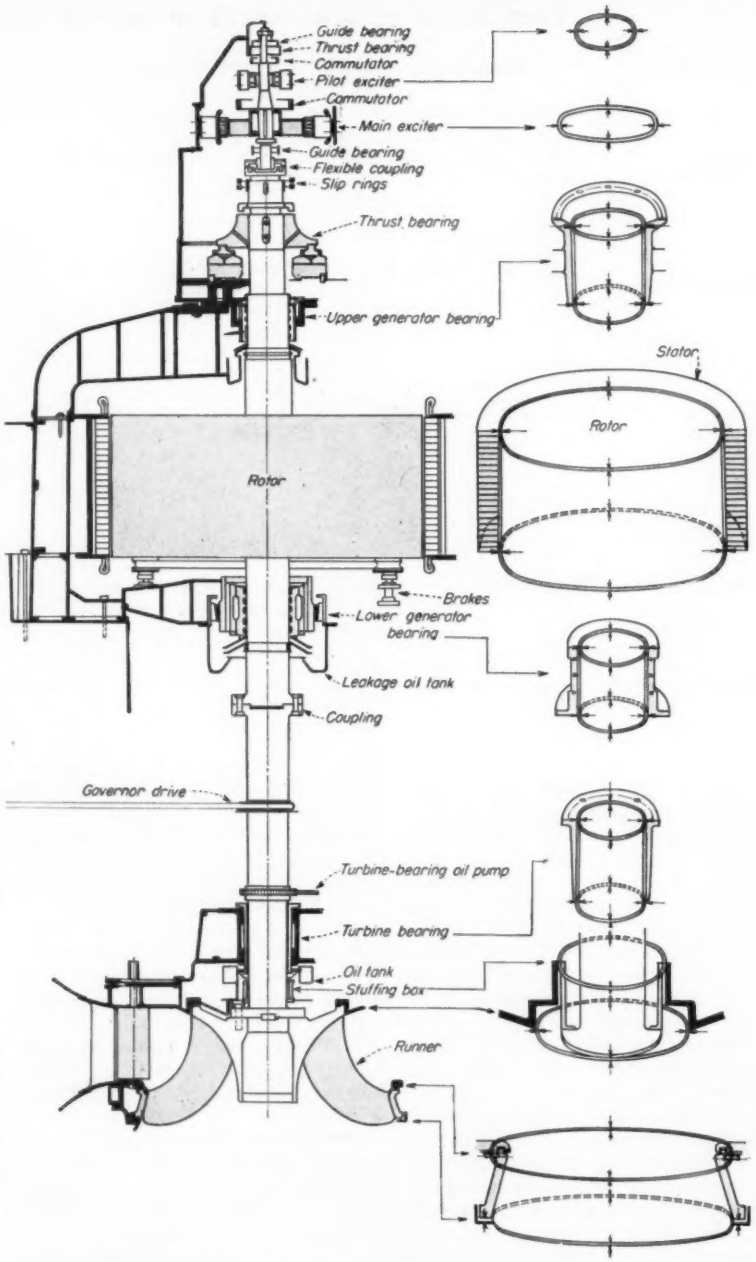
3. Phase-to-neutral test is made with one terminal of stator winding connected to neutral of generator star connection inside all current transformers. With machine running at normal speed, excitation is raised until inter-turn relays operate. Once again the value of excitation current is noted.

As with the ground relays, the no-load voltage curve shows through the excitation current, the value of emf at tripping. With three of the machines here at Ardnacrusha this value was found to be as high as 90%. Relay setting couldn't be lowered without inviting trouble by possible operation on a phase-to-phase external short circuit. These relays will be replaced.

4. Three-phase short-circuit test is made with generator running at normal speed and a short applied outside the bus-bar current transformers. With excitation adjusted from zero to full current, record is made of stator and field currents. Curve is drawn showing machine's full-load characteristic.

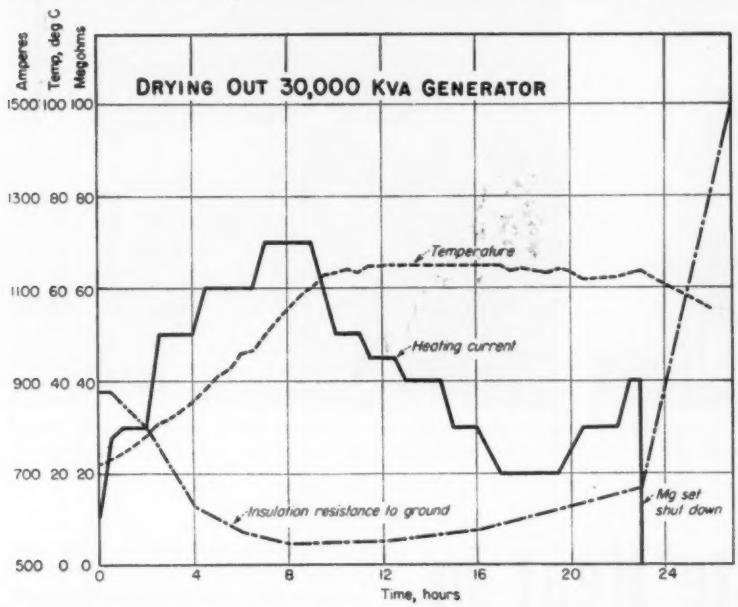
As in previous tests, this curve is

Generator Overhaul Includes Checking Bearings



CLEARANCES NOTED at above points after unit is reassembled. Points again checked before next overhaul. All clearances recorded directly on this alignment drawing

and Drying Out the Stator Windings With Mg Set



MOISTURE ABSORBED by generator winding during overhaul is driven off by sending dc current from mg set through stator coils. Generator windings connected in series

compared with that plotted when machine went into operation. Also during this test, values of leakage current in each phase of differential relays are taken and plotted against stator current. Resultant graph is extrapolated and a check is made on the margin of safety against machine tripping by differential relay action for a fault external to generator.

Overcurrent relays are checked by running unit at normal speed and setting each phase relay in turn at a value below the other two. Generator is then excited until relay operates. Test ammeter checks value of stator current at which relay trips.

5. Second 3-phase shorting test is run inside bus-bar current transformers. Once again the generator is run at normal speed, and each phase of differential relay is set at normal value while other two are set higher. Generator is then excited until relay operates. Value of stator current at which this occurs is then checked by test ammeter and compared with relay setting. Actual tripping value of relay current is measured and compared with bench test values.

6. Two-phase short-circuit check is last test in this series. Load is applied outside bus-bar current transformers. Generator is excited from zero to full-load current. Voltage across ground relay is noted and plotted against value of current flowing in the stator winding.

Margin of safety, in light of accidental operation of this relay on a 2-phase short, is checked by extrapolating voltage curve. This test must be completed in a short time to prevent rotor overheating. Simultaneously with test on ground relay, current and voltage on inter-turn relay are plotted against stator current. Margin of safety against accidental tripping here is checked like that for ground relay.

Other Tests. Overspeed relay is removed from the machine and checked by driving through a gear chain. Fire extinguishers, CO_2 type, are checked for gas content by weighing. Protective circuits are tested for coordination between various relays. This test is repeated every month. It means impressing voltage or current through pushbutton control to main relays. Aim is to check operating sequence for auxiliary relays. Here is the correct sequence for one of the generators:

For an external fault, time-delay operation of the overcurrent relay or instantaneous operation of the overvoltage relay will (1) trip generator circuit breaker (2) open exciter circuit (3) send signal to indicate type tripping (4) sound an alarm.

For an internal fault the interturn, differential or ground-fault relays will, in addition to the above, (1) trip air-circulating fan motors, (2) release CO_2 into the generator.

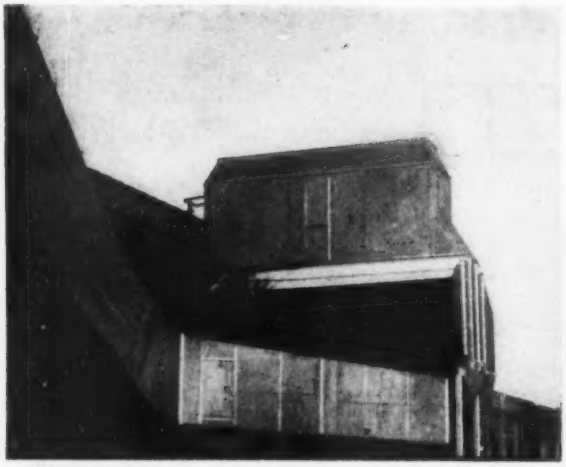
For a governor fault involving overspeed, the overspeed relay will (1) drop the sluice gate (2) trip an indicating relay, and (3) sound an alarm.

Drying-Out Generator. During major overhaul, moisture is bound to penetrate generator insulation. To dry out, machine is run at normal speed with terminals short-circuited. Exciting current is adjusted to bring stator to about 70 C. This temperature is held while insulation-resistance tests are made.

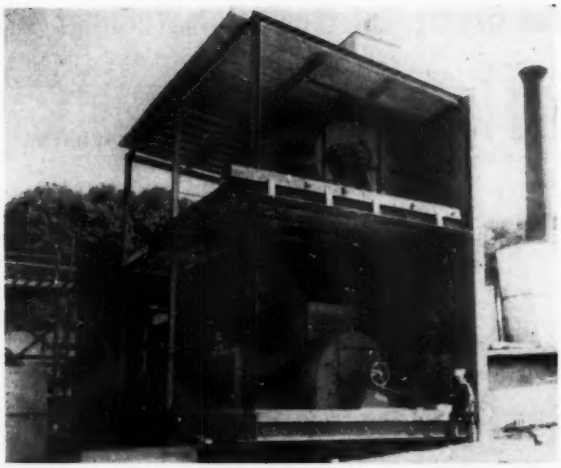
As drying out proceeds, insulation resistance continues to drop. Eventually it reaches a minimum value and holds constant for some hours. Then it tends to rise, as shown in above curve. After about 24 hr, if rise continues or if insulation resistance levels off over 8.5 megohms, machine excitation is interrupted. Current flow from machine stops and temperature starts to drop. Temperature and insulation-resistance readings are still taken until temperature reaches about ambient. Insulation resistance should approach infinity in a straight-line curve. Drying-out process is then complete. Entire operation takes from one to four days.

But this method has a major drawback. For a 2-day dryout a machine consumes water equivalent to 200,000 kwhr. To reduce this cost a separate mg set was provided. Its 230-hp motor is fed from station transformers at 380 v, 50 cycles. Generator supplies 1500-amp dc at voltage varied between 0 and 110. When connecting up, the windings of main generator are connected in series. Dc voltage needed is less than ac because of absence of reactance and skin effect. On the other hand, dc does not heat stator core by eddy current and hysteresis losses. With mg set, only about 4000 kwhr are used for a 2-day dryout. This is a considerable saving—about 98% compared to the method previously described.

Transformers in 10/110 kv class are serviced monthly, annually. During annual overhaul all connections are checked, bushings examined, cooling mechanism inspected. Thermometers and thermostats are checked. Oil is filtered, then tested. One such transformer in another station was opened after 22-yr service. There was no oil-sludge in evidence; unit was in good condition.



1 Economizer and its ductwork on roof of a paper mill are located for good intake conditions, low-cost installation



2 Typical economizer during construction showing air supply and exhaust fans, heat exchanger and connected ductwork

Recover Waste Heat in Plant Exhaust Air to Cut Steam and Fuel Costs

With an air-to-air economizer you can heat incoming cold air with outgoing exhaust. Savings are appreciable in many types of plants. Here are the facts on design, application, savings

By HOWARD McCALL, *Industrial Engineer, J O Ross Engineering Corp*

► IF YOU EXHAUST sizable quantities of warm air from process areas in your plant, you should consider the possibilities of waste-heat recovery. One proven method uses the Briner economizer. This unit, named after its inventor, is an efficient heat interchanger for abstracting heat from air and vapor exhausted from industrial plants.

Economizer Details. Fig. 4 shows typical economizer setup for a paper mill. Hood over paper machine confines vapor-laden hot air to area around machine. Connection at hood top or side leads to exhaust fan discharging to atmosphere.

Before entering fan, the hot air passes through plate-type economizer. Outdoor air for machine and room ventilation passes over one side of the economizer's plates, and is heated by the warm exhaust on the other side. Operation resembles that of plate-type combustion-air preheaters for steam boilers.

To obtain maximum heat recovery, water sprays discharge into the exhaust air leaving paper machine. The cold water is heated during its fall through the warm air, and is collected in sumps before being pumped to mill. Eliminators trap any water carryover before it reaches the fan.

Uses. Paper, textile and allied plants are a few in which Briner economizers prove out. As a rule-of-thumb guide you should consider an economizer whenever you exhaust moderate or large quantities of warm air or vapor, and need a heated supply of outdoor air. Every Btu recovered by economizer saves an equivalent amount of heat that must be put into a boiler furnace to generate steam or hot water.

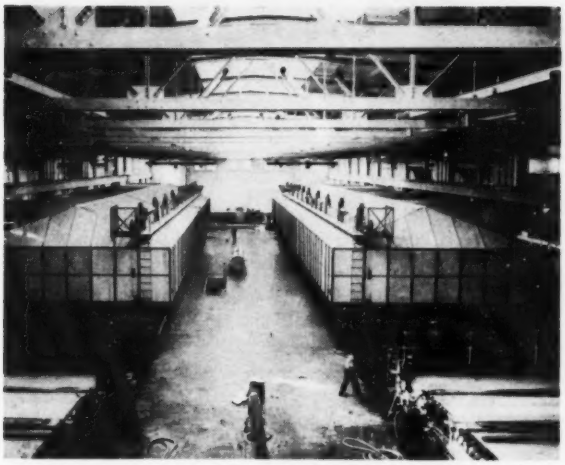
Final decision on economizer use rests in an engineering study that compares investment and operating costs with possible savings. This is best made by an engineer familiar with all factors involved.

Savings Possible. In a number of industries, like paper making, air is an essential material in the manufacturing process. For instance, 60 tons of dry air per ton of certain grades of paper must be heated by steam or hot water. This works out to about 1.2 lb steam per lb of paper.

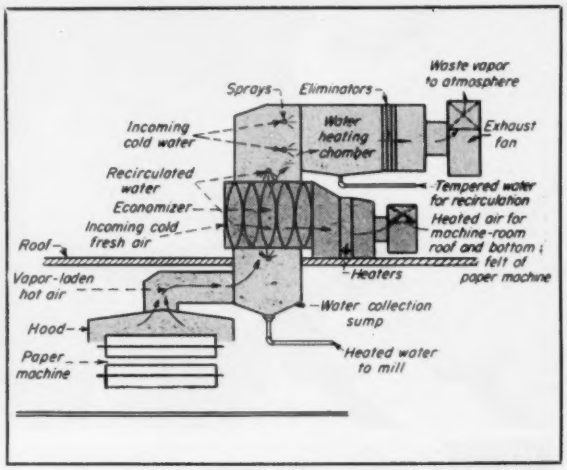
Table I shows savings with an economizer in a 100-ton mill working 25 days per month. As you'd expect, savings are greater for lower outdoor temperatures. In this mill the economizer saves 11,700 lb of steam an hour when outdoor temperature is –20 F, 4100 lb when it is 60 F. In dollars, savings range from $5260 to $1840 per month.

Warm Climates. Figures in Table I leave no question as to savings in northern areas. But what about warmer areas where outdoor ambient is higher in winter, spring and fall? Table II shows savings in our 100-ton mill when located on the design isothermal passing through St. Louis, Cincinnati and New York City.

In this region the average temperature for the three coldest months of the year is 32 F; for the five next coldest months it is 51 F. Tabulated savings are for heating 112,000 cfm 25 days a month with steam having an enthalpy of 970 Btu per lb; cost 75c per 1000 lb.



3 Hoods over these paper machines have side connections leading to Briner economizers. Transite hoods insulated



4 Cross section of a typical Briner economizer equipped to heat air and water for a paper mill. Layout is variable

Note that total annual saving is $21,400. Moving this mill farther north boosts the saving possible. In many plants the steam savings pay for the economizer in a few years and return large dividends thereafter. Savings are further increased in paper mills where heated air from economizer can be used in summer as well as in winter.

Steam savings when economizer heats water may also be large. One mill reports an annual saving of $8936 when heating water. Investment for a water-heating installation is relatively low compared with saving.

Cost Estimates. Fig. 5 permits easy figuring of steam cost for heating air used for machine-room ventilation. It's based on a steam cost of 40c per 1000 lb, but can be used for other conditions if results are multiplied by the ratio of new cost to 40c.

Suppose we'd like to know savings of an average machine with an economizer when outdoor temperature is 30 F. Enter the chart at the bottom at 30 F and project vertically to average machine curve. At the left read steam cost as $0.24 per ton of paper. Continue this line to curve for average machine without an economizer, and read $0.91 per ton at left. Saving possible with an economizer is difference in the two costs, or

$0.91 – 0.24 = $0.67 per ton.

With 0-F outdoor temperature, Fig. 5 shows that steam cost without economizer is $1.24; with one it is $0.31. Saving possible is $0.93 per ton output of paper. Note that economizer-equipped machines have fairly flat steam-consumption curves, whereas machines without an economizer have steep curves.

Other Industries. Though this discussion is concerned primarily with paper mills, savings in other plants are comparable. Exact amount, in dollars and cents, depends on quantity and quality of air heated, cost of steam, and amount of water that may also be heated. Additional cost of fans for the economizer may usually be neglected because units with about the same capacity are needed whether economizer is used or not.

Construction. Economizer heat-exchanger section is usually fabricated from corrugated double-galvanized-steel sheet metal. Sump section is made from steel plate, while spray section, eliminators and casing are galvanized-steel sheet metal.

Hoods, Fig. 3, for paper and textile mills are made of asbestos-board panels, sheet metal or special alloys. With panel construction, sections of hood are easily removed without affecting other parts of the structure.

Design. Computation of heat loads, air quantities and economizer capacity is best done by an engineer familiar with the problems involved. Though Briner economizers are not complex units, they are best built by firms specializing in this work.

Many installations prove you can make substantial savings in new or existing plants with an economizer. So give it serious consideration whenever large quantities of outdoor air or process water must be heated, and there is sufficient exhaust air at a high enough temperature (about 120 F) to do the job.

I: 100-Ton Mill Savings

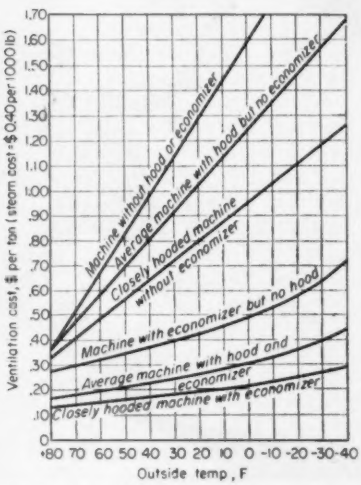
Outdoor temp, F	Economizer air outlet temp, F	Temp rise, F	Equivalent steam lb/hr	Saving per 25 day mo*, $
–20	72	92	11,700	5260
0	78	78	9900	4450
20	84	64	8100	3640
40	90	50	6350	2860
60	96	36	4100	1840

*Steam cost = 75c per 1000 lb

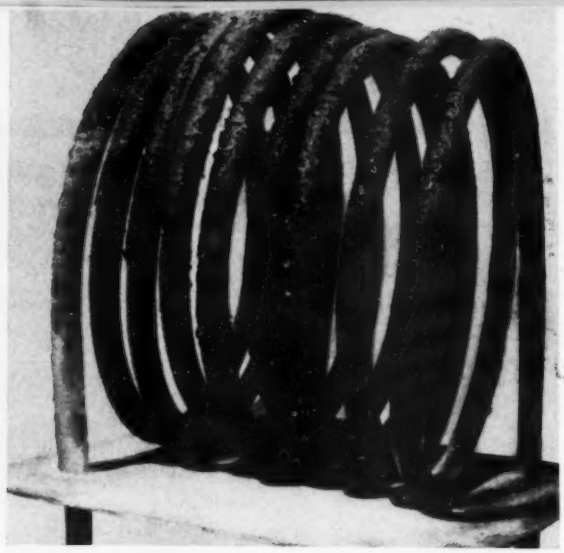
II: Warm-Climate Savings**

	3 coldest mo	5 intermediate mo
Average outside temp, F	32	51
Economizer air-outlet temp, F	87	93
Temp rise, F	55	42
Average Steam saving lb per hr	6980	5340
Average daily saving, $	126	96
Saving for period, $	9400	12,000
Total annual steam saving, $	21,400	

**Steam cost = 75c per 1000 lb



5 Use this chart to compare ventilation costs with and without an economizer



WITHOUT: Typical slag forming on all superheater tubing with untreated oils is bonded deposit that resists ordinary cleaning methods of air, steam soot blowers. Only sure removal is to shut down, then wash, check manually

WITH: Special additives in plentiful supply to keep them cheap, properly mixed with fuel oil before combustion zone produces a slag that can be readily removed by just air lancing. Exact nature of deposit depended on the additive used

Superheater Slag Bows to Additives

J B McILROY, E J HOLLER
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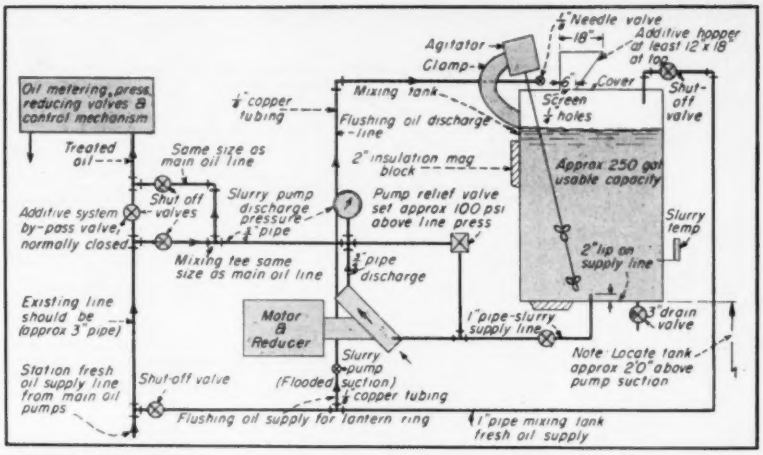
Editor's Note: McIlroy, Holler and Lee are co-authors of "The Application of Additives to Fuel Oil and Their Use in Steam-Generating Units," ASME paper No. 52-A-160, New York, annual meeting, Nov 30-Dec 5, 1952.

► THREE MAJOR FACTORS move the problem of slagging and ash build-up in oil-fired furnaces from the ordinary to the critical stage. These factors—progressive deterioration of available fuel oils, higher superheater metal temperatures, a rising frequency of boiler-user complaints—drive home the need for intensive studies backed up by an integrated research program.

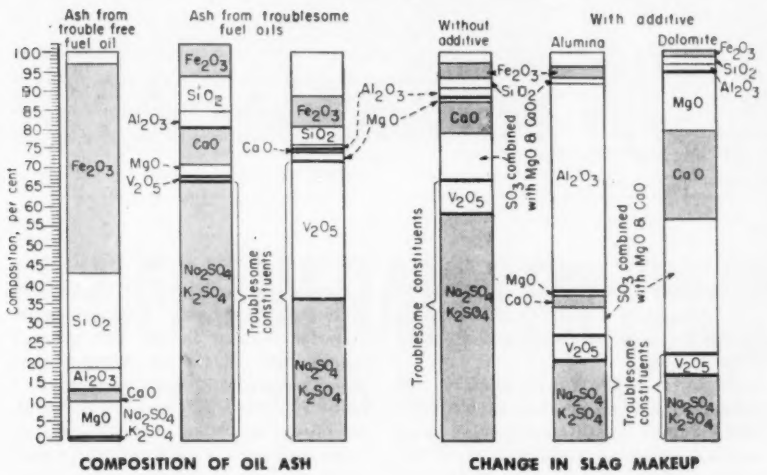
Out of one such program comes a solution that reduces cleaning labor and gives good operating efficiencies with present-day oils. What's more, the corrosive qualities of the stack gas appear greatly reduced and the flyash nuisance considerably lessened.

The Problem. In a nutshell, the larger oil-fired steam generators of recent years are crippled by (1) fluxing of refractory furnace walls (2) slagging of the high-temperature superheater surfaces


Oil metering, press. reducing valves & control mechanism
Treated oil
Same size as main oil line
Shut off valves
Additive system by-pass valve, normally closed
Slurry pump discharge pressure ½" pipe
Mixing tee same size as main oil line
Existing line should be (approx 3" pipe)
Station fresh oil supply line from main oil pumps
Shut-off valve
Motor & Reducer
Slurry pump (Flooded suction)
½" copper tubing
Flushing oil supply for lantern ring
Mixing tank
Flushing oil discharge line
2" insulation mag block
Pump relief valve set approx 100 psi above line press
1" pipe discharge
1" pipe-slurry supply line
Slurry pump suction copper tubing
1" pipe mixing tank fresh oil supply
Agitator
Clamp
¼" Needle valve
18"
Additive hopper at least 12" x 18" at top
6"
Cover
Screen ¼ holes
Shut-off valve
Approx 250 gal usable capacity
2" lip on supply line
Slurry temp
3" drain valve
Note: Locate tank approx 20" above pump suction

MIXING TANK, 250-gal capacity, contains enough oil-additive material for 8 hr run. It is mixed with heated oil from the regular supply at 1 lb to each gallon of oil

Nature of Fuel Ash in Oil as Fired Affects Slagging Difficulties



STUDIES of fuel-oil ash over a period of years show sharp change in materials

SULFATES, pronounced bonding agents, show up in oils, now coming to market

with deposits that resist the ordinary air or steam soot blower (3) fierce attack on steels, including high chromium-content alloys such as superheaters and hangers, when metal temperatures get above 1200 F (4) coating of boiler, economizer and heater surfaces, and (5) plugging and corrosion of cold sections of the heaters.

Superheater slagging is far and away the most serious. It results in lower availability, increased draft loss, lowered steam temperatures, an accompanying drop in boiler efficiency. In some plants outages for cleaning occur as often as once a month.

The culprit is easily identified. Early records show oil-ash contents ranging from 0.01% up to 0.1%. Today ash content often runs twice that much, 0.2%, and as a common thing ranges from 0.1 to 0.15 And to really make matters worse the nature of this ash has changed just as drastically. In former days this ash content consisted of iron oxide, silica, lime and magnesia compounds with traces of other materials, bar chart, above. The picture today, though, same chart, shows an ash containing large quantities of alkali sulfates and often considerable vanadium. Source of the vanadium is the crude itself. It runs much heavier in some crudes than in others. Venezuelan fields, for instance, yield crudes notoriously high in vanadium.

Alkali sulfates and vanadium pentoxide, both with low fusing temperatures, prove the principal constituents of troublesome superheater slags, serving as the most active bonding agents. They appear in these slags in far greater proportion than in the oil ash. And their highest concentration shows up in the inner layers of the deposits next to the tube surfaces, becoming progressively less toward outer layers. As you might expect, sintering temperatures of these outer deposit layers get higher and higher with each layer.

New superheaters and those cleaned to bare metal by washing enjoy a period of immunity of several months, when no slagging occurs. Bonding agents in the flue gas do not seem to stick. Once they do start, though, slag deposit is rapid. Mechanical or manual cleaning never completely removes slag and build-up starts apace when the boiler goes back into service.

Various constituents of slag deposits have different melting points and sometimes the surrounding atmosphere affects this temperature too.

Laboratory Investigations. These objectionable ash constituents are present in such small amounts and in such chemical combinations in the crude and fuel oils that you can't remove them economically on a commercial scale. So our move was to see if we could add some material to the oil to raise fusing temperature of the ash. We ran many laboratory tests on alumina, calcium oxide, magnesium oxide, silica, barium oxide and sodium chloride. Alumina, calcium oxide and magnesium oxide raised fusing temperature of ash and slag when mixed in 1 to 1 ratio. Silica worked only with 5 to 1 mix.

Pilot-plant tests followed these chemical investigations. We mixed additive material with the oil before combustion. This gave a thorough mixing with oil-ash solids so the additive particles could (1) serve as nuclei for depositing oil-ash vapors or solids (2) allow maximum time for high-temperature-reaction ash-additive solutions to form.

Deposit was collected on coils in the flue-gas stream. Flue gas passed over these air-cooled coils, photos, p 86, with air flow through the coils regulated to hold the metal temperatures at about the point they would be in a high-temperature superheater. Deposits collected on coils were analyzed following each run. Before testing materials, a trial without additive was made. Material collected on the coils was a hard slag like that from actual superheaters in the field, top photo, p 86.

A wide variety of materials was added

SPECIFICATIONS AND PRECAUTIONS—SLURRY MIXING

MIXING TANK

3-ft 6-in. dia by 4-ft length—285 gal.
Working capacity—volume actually pumped out before refill—250 gal.
Insulate with 2-in. magnesia block on side and bottom.
Install right-angle thermometer in well side of tank to give slurry temperature
Let slurry supply pipe stick-up above tank bottom about 2 in.
Install screen in bottom of hopper with ¼-in.-dia holes.

AGITATOR

No. 115 portable gear mixer complete with clamp and ½-hp explosion-proof 440-v ac, 60-cycle, 3-ph motor-gear reduction of 1720 to 420 rpm—shaft and two propellers suitable for tanks 3-ft 6-in. dia and 4-ft height (cost $250). Actual power consumption measured at 0.25 hp handling 12% concentration of additive in fuel oil at 130 F. Set lower blade as near bottom of mixing tank as possible to prevent additive settling. Run agitator continuously.

ADDITIVES

Finely divided alumina
Selected collector fines
Screen size 98% through 325
Price lots 2000 to 19,999 lb — 4.50c per lb
20,000 to 39,999 lb — 3.5c per lb
over 40,000 lb — 3.25c per lb
Dolomite—Red Level Mine, Inglis, Fla.
100% through 325
Price—About $12 per ton at the mine

SLURRY CONCENTRATION

Assume 20,000 lb oil per hour.
Assume 0.15% ash in the oil.
Assume additive to ash ratio 1:1.
20,000x0.0015 = 30 lb ash per hr.
30 lb additive per hr, or 240 lb additive per 8-hr shift.
Assume 8.136-lb oil to a gallon.
Mixing tank will mix 240-lb additive with 250 gal of fresh fuel oil to make an 8-hr batch of slurry.
Therefore the additive concentration will be:

$$\frac{240 \times 100}{250 \times 8.136 : 240} = \frac{24{,}000}{2270} = 10.6\% \text{ additive by weight.}$$

SLURRY PUMP

Simplex pump with single cover plate to handle a maximum of 35 gph of specified fuel oil with 10% additive suspension at specified temperature against a specified discharge pressure (oil header pressure). Operation to be with flooded suction. Unit will be equipped with variable-screw adjustment of plunger-stroke length from 0 to 100%.

Construction materials: Cast-steel liquid end, stainless-steel ball checks, ball seats and plunger of 18-8 stainless steel hardened to 500 Brinell.

Pump to be provided with flush stream connection to lantern ring. Fresh fuel oil fom the main oil-supply line is run into the lantern ring, and discharge is run into mixing tank. A small needle valve on discharge side limits flushing oil flow to a trickle. Actual power consumption measured at 2.44 hp handling 12% concentration of additive in fuel oil at 130 F temperature.

Recommended spare parts:

1 plunger
1 set 4 balls
1 set 4 ball seats
2 sets packing
1 cover plate
1 set of rod bushings

MIXING TEE

Provide in the additive loop of the main oil stream under conditions of turbulence for mixing action. In the piping arrangement, fresh oil meets the slurry "head on." Both streams must make several 90-deg turns before reaching the oil burners, thus providing more turbulence or mixing.

ADDITIVE DISTRIBUTION

Distribution of additive to each burner position serves as check on quality of mixing accomplished. Individually treated oil samples taken from each burner line can be analyzed for their additive content. Equal distribution indicates good mixing.

PRECAUTIONS

Additive has tendency to settle out in mixing tanks. Keep agitator in use.

Sometimes sludge, forming on bottom of mixing tank, is carried over into pump. Sludge can hold ball check valves off their seats and prevent further pumping. Clean pump chamber.

Sludge in pump chamber can sometimes be melted by heat lamps beamed onto the pump casing.

Pump can become airbound by sucking air in through packing gland. Look for sludge in pump housing and tighten packing gland very *slightly*.

Sludge can unseat pump relief valve, causing a reverse oil flow from header back into mixing tank.

Keep the unit oil-return lines closed while adding additive to prevent recirculation of treated oil back through the oil heater and main oil pumps.

Alumina-treated oil is very abrasive at high velocities. Wear has shown up in oil-burner sprayer plates and ball seats.

Dolomite because of its lower specific weight requires more care in mixing than alumina.

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to the oil during these tests, including the four that showed promise in the fusing-temperature experiments. Results of the laboratory fusing-temperature tests on the ash and additive mixtures were a guide in establishing the quantity of additive used in the tests.

The gratifying results demonstrated, lower photo, p 86, it was possible to obtain a dry, powdery, easily removable deposit, with high fusing temperature, by adding suitable material to the oil. Alumina added in an amount equal to ash in the oil produced the best results, with magnesium oxide and calcium oxide following in that order. Increasing alumina above this quantity did not add appreciably to the benefits. To prevent settling in lines and valves and also to permit necessary intimate mixing with the oil, fineness of the alumina should be 98% through 325 mesh.

These pilot-plant tests indicated that additives might offer a practical and economical solution to the oil-slag problem at the working-plant level, as at Inglis, Fla., station, Florida Power Corp. Alumina cost in carload lots is about $.0325 per lb. Based on burning an oil having 0.1% ash and adding alumina in an amount equal to ash in the oil, alumina cost for a 100,000-lb-per-hr-capacity boiler would be about $1650 per year, assuming a boiler load factor of 80%.

Inglis normally burns slightly less than 20,000 lb of oil per hr for the 275,000-lb-per-hr load. Using alumina in an amount equivalent to the quantity of ash in the oil, alumina-additive cost runs about $1 per hr, or $750 per month.

Adding alumina to the oil increased burner atomizer wear to the point where standard sprayer plates had to be renewed every 30 days. Special plates of hardened steel alleviated this problem to an extent, but wear was still excessive.

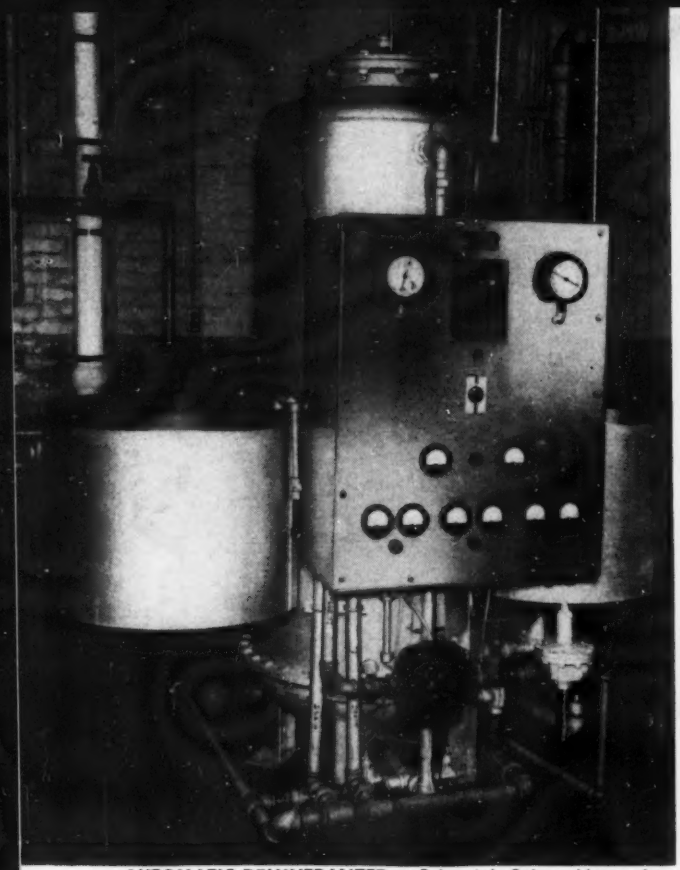
Although the alumina additive greatly alleviated the slagging problem we hoped for even better results at lower cost. Dolomite, a natural mixture of calcium and magnesium carbonates, lay close at hand in the vicinity of Inglis, Fla. Since both calcium and magnesium carbonates had showed up well in the laboratory tests, we discontinued alumina and tried dolomite. Material selected from dolomite roasting-kiln gases has a 100% fineness through 325-mesh screen and costs about $.006 per lb, less than one-fifth the alumina cost.

Results at Inglis with dolomite have been very favorable. Although more material deposits in the first gas-passage section of the superheater than with alumina, it is fine, powdery, more easily removed. Section of superheater extending into the second pass and boiler surface in second and third passes remain substantially clean. Wear rate of the sprayer plates when using this dolomite continues high. But at another plant, using dolomite from a different source, wear is slight.

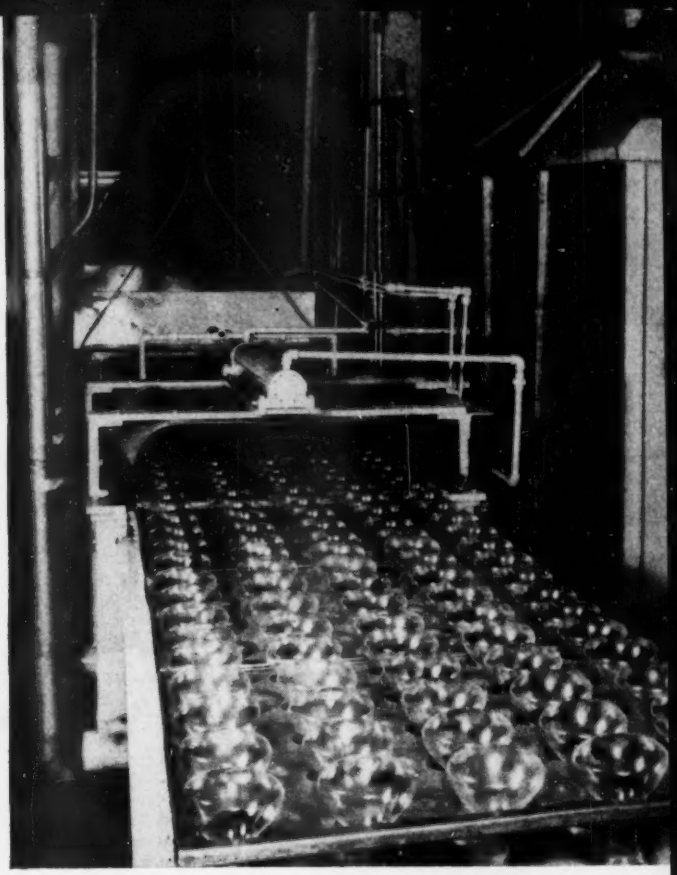
Effect of dolomite on air-heater corrosion is not yet fully known. But, the major nonmetallic constitutent in the dolomite ash is $CaSO_4$, so a much smaller amount of free SO_3 is probably present in the air heater. A suitable apparatus for checking dew points of gases is used at Inglis and Higgins stations of the Florida Power Corp and at a Tampa Electric Co station. It indicates there may be a difference between dew-point temperatures when firing the same oil with and without additives.

When firing a 2.75% sulfur fuel, dew-point temperature of 150 F was recorded while using dolomite as an additive. Without additive, and using the same

(*Continued on page* 212)



AUTOMATIC DEMINERALIZER at Sylvania's Salem, Mass. plant supplies process water needed for infrared bulb manufacture



BULB WASHER, designed and constructed by Sylvania, carries bulbs through washing process, then rinses and dries them

DEMINERALIZER SLICES PROCESS-WATER COSTS FOR THE ELECTRONICS INDUSTRY

By **EDWARD H CLOHESSY,** *General Manager, Penfield Manufacturing Co, Inc*

► EVER STOP TO THINK that in some production processes water treatment is just as important as in boiler operation? It is, and two good examples are infrared lamp and television-tube manufacture.

Impurities. Dissolved solids and gases in process water used for infrared lamp production can cut lamp service life. Clean glass surfaces are absolutely essential for high-quality lamps.

In television-tube manufacture, water is used to clean glass skeleton and to prepare tube screen. Water purity is a critical factor because impurities cling to glass surfaces, causing distortions when electrons bombard screen. They also cause further distortion by preventing proper and even distribution of fluorescent screening materials on screen.

Lamp Manufacture. Sylvania Electric Products, Inc, needed a good, low-cost supply of industrially pure water in their Salem, Mass. plant. Water was to be used in manufacturing built-in reflector infrared lamps that have a metallic reflective coating.

For best results water with virtually no mineral impurities, obtainable at low cost, was needed. Dependable operation with a minimum of supervision was also a must.

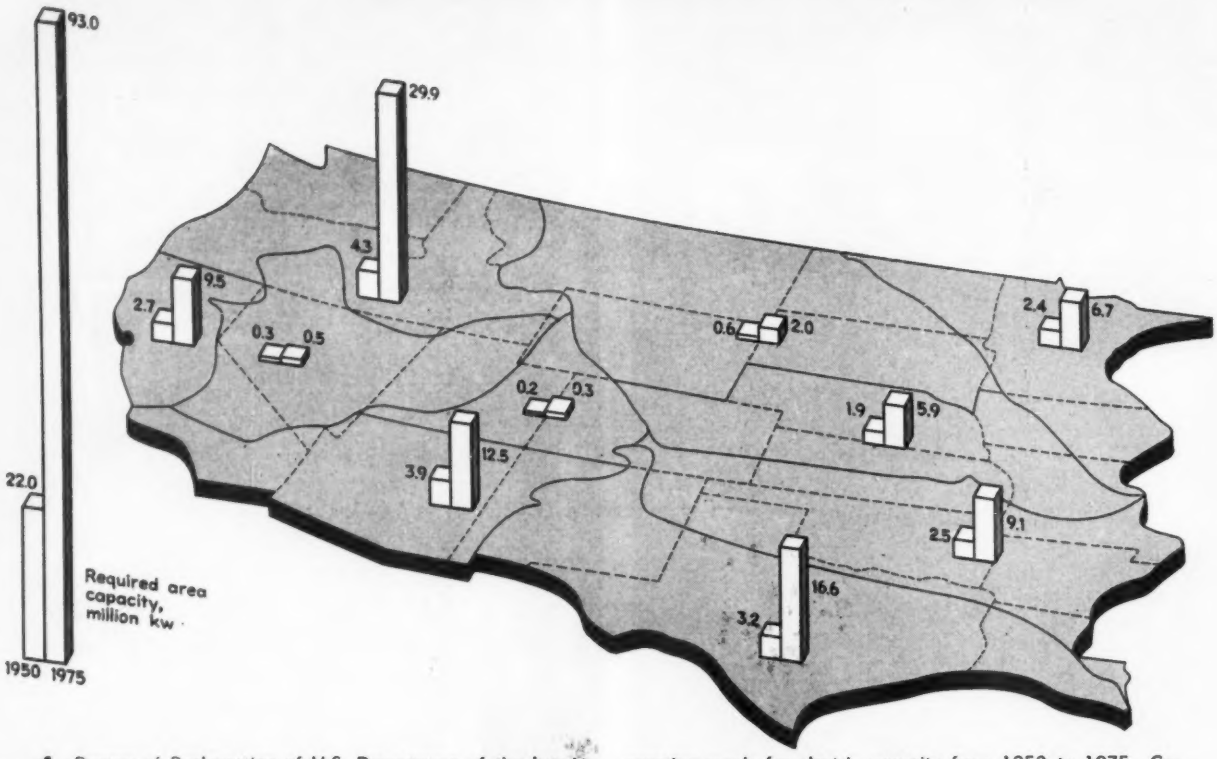
Demineralizer. To do this job a Penfield automatic demineralizer, above left, was chosen. This unit performs all its operating functions, including regeneration, automatically. No operator is needed.

Incoming Salem city water of 7000- to 8000-ohm resistance first goes through an 18-tube filter that removes organics, large solids and other suspended impurities. From here it passes through demineralizer, which has a rated capacity of 140 kilograins $CaCO_3$ and a nominal flow rate of 1200 gpm. Leaving demineralizer water passes through a check filter as a precautionary measure. Pipes of 316 stainless steel convey water to the automatic bulb washer, above right.

In normal operation, water from demineralizer has a resistance of more than 4 million ohms after regeneration. Five days' continuous use reduces resistance to a value of not less than 1 million ohms.

Automatic signal indicates when regeneration is needed. Regeneration tanks are automatically refilled with fresh water so new acids and caustics may be added for next regeneration cycle.

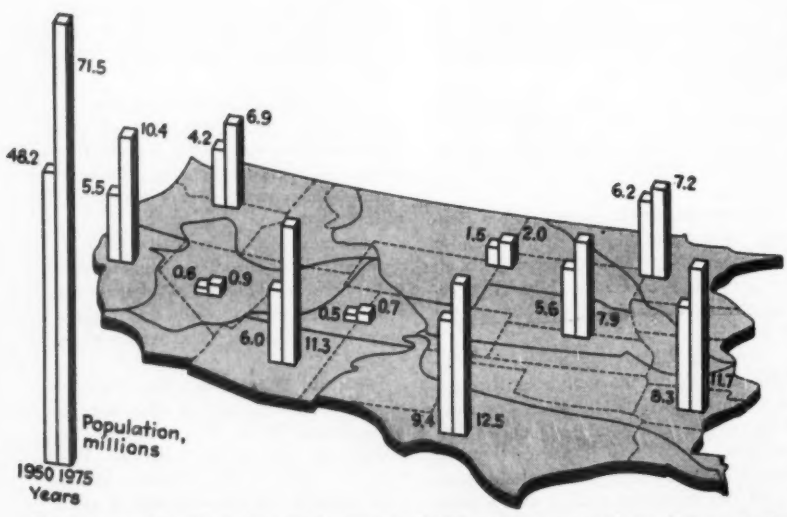
Television Tubes. Here, trace elements of copper, as few as 0.1 ppm, may reduce screen life by 50%. Organic materials can also reduce tube life. Pure process water is the answer. Demineralization is one low-cost way of assuring that electronic products have good-quality process water at all times.



1 Bureau of Reclamation of U.S. Department of the Interior sees all watershed areas in western states experiencing zooming needs for electric capacity from 1950 to 1975. Capacity needed may be supplied through transmission lines net

Reclamation Bureau Looks At West's Power Future

Population growth trends show huge potential for future increased power demands in 22 states west of Mississippi River. Hydro capacity, despite fourfold expansion anticipated by 1975, will not meet even half total demand. So coal must make up the difference, carry major part of the load



2 Estimate of increased power demands by 1975 rests on expected population growth and increased industrialization. Western population grows faster than nation's

► UNOFFICIAL ESTIMATES of U.S. Bureau of Census place national population in 1975 between 160 and 225 million people compared with 151 million in 1950. Percentagewise, the 22 western states have grown consistently faster than the nation as a whole. From 1940 to 1950, these states increased by 19% compared to the national 11%. The Pacific Coast states chalked up gains of 37% for Washington, 39.6% for Oregon, and 53.3% for California, highest for the nation. In 1950, the 22 western

states had about 48,200,000 people. Estimate for 1975 reaches about 71.5 million, Fig. 2.

Electricity Use. Annual energy consumption per capita has jumped from 455 kwhr in 1924 to 2888 kwhr in 1951. Bureau of Reclamation estimates that in 1975 this will reach at least 7500 kwhr. In the western states with their increasing industrial development this consumption may well be 8500 kwhr per capita. Total western annual energy requirements are estimated at about 550 billion kwhr, Fig. 3. This will need power-plant capacity of about 93 million kw, Fig. 1.

Industrial Needs. Electrometallurgical and electrochemical industries form an important part of the West's industrial activity. Their products have enormous appetites for electrical energy, Fig. 7. General manufacturing methods turn more and more to electricity—for example, welding and heating. In 1950, the average industrial worker used 13,000 kwhr per year. This could very well double by 1975. Combined effect of increased utilization and increased working force is expected to increase industrial consumption in the West as shown in Fig. 6, according to Reclamation Bureau estimates.

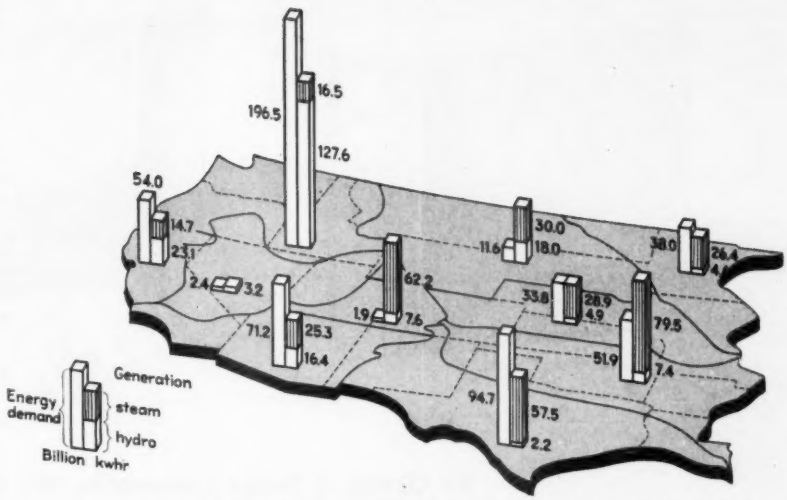
Domestic Use. In 1950, the average home used 1830 kwhr per year. But since electrical utilization in the home is far from saturated we can expect tremendous increases in electrical applications. For instance, a St. Louis demonstration home in 1952 used 24,000 kwhr annually, including 13,980 kwhr for heat-pump heating. By assuming the 1975 average western home would use only 35% of this amount the Reclamation Bureau figures an annual demand for 140 billion kwhr, Fig. 6.

Other Uses. An increased number of commercial establishments and greater use of air conditioning, electric heating, motor-operated equipment and higher lighting levels will probably send commercial needs up to 85 billion kwhr by 1975, Fig. 6.

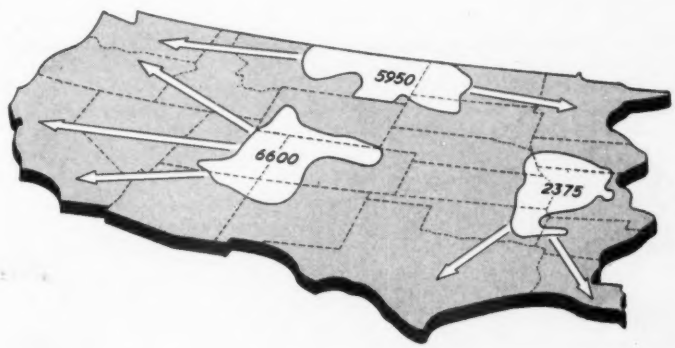
Rural and farm homes represent about the biggest percentage growth for potential electrical uses. These homes have great need for refrigeration, pumps, heaters and labor-saving machinery. By 1975, this type of load could easily use 50 billion kwhr annually, Fig. 6.

Miscellaneous uses, like railroads, street lighting, railless trolleys, air fields, military establishments, all will need greater amounts of electric energy. These will contribute to the increased demand for the western states, Fig. 6.

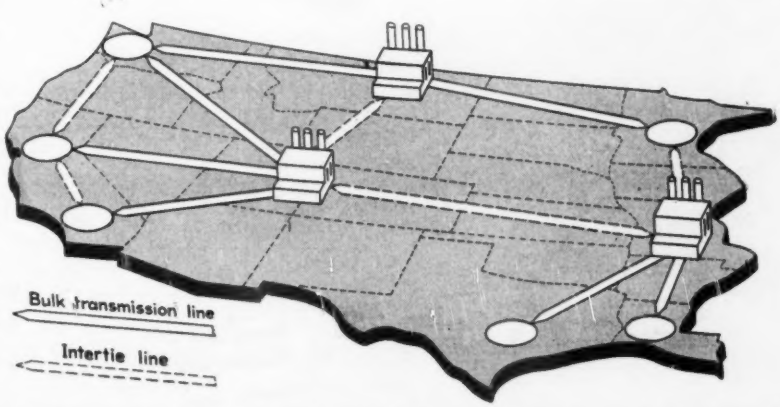
Power Sources. The Bureau estimates that the U.S. has total ultimate hydro power of 100 million kw, with 80 million



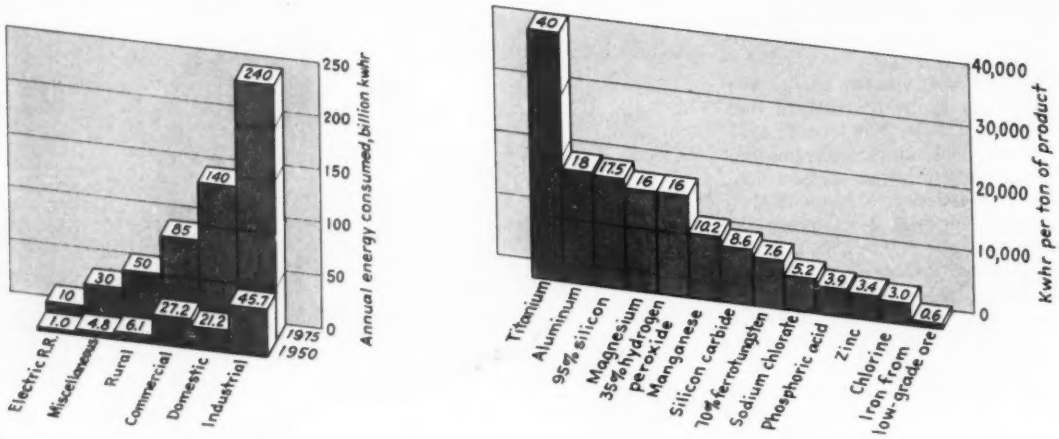
3 Pacific and southern watershed areas in 1975, expected to need more energy than they generate, could be supplied from coal-rich interior states by transmission



4 Energy in recoverable reserves of coal and lignite can be sent by rail or transmission lines to energy-hungry areas. Energy figures are million billion Btu's



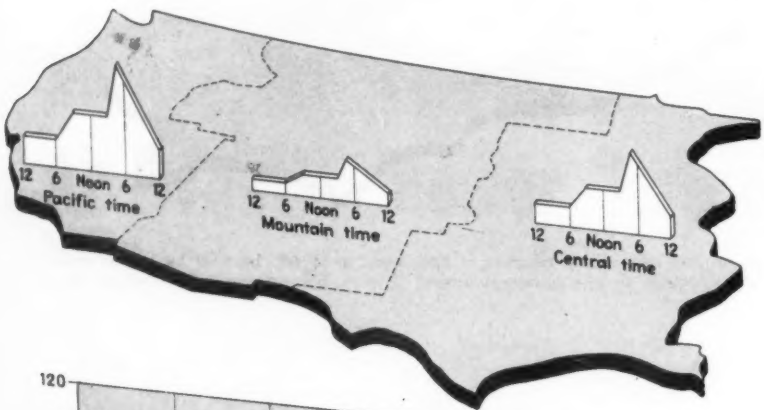
5 Reclamation Bureau study anticipates high-voltage transmission network as most economical method of transporting bulk energy over distances up to 660 miles

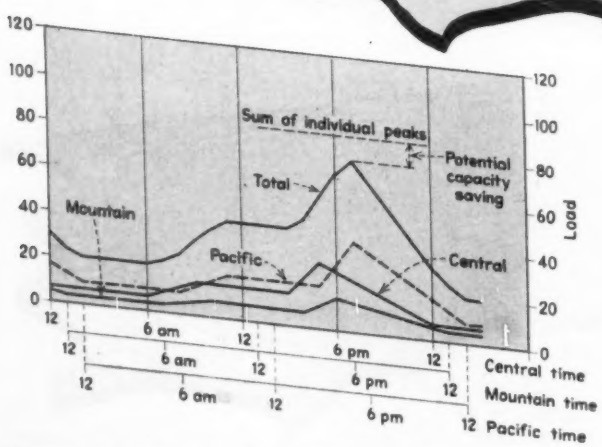


All Classes of Energy Consumption Will Grow

6 Electricity has just begun to be applied according to estimate of future need; increasing population adds to growth

7 Process needs for various products will boost industrial consumption of electrical energy way beyond present levels

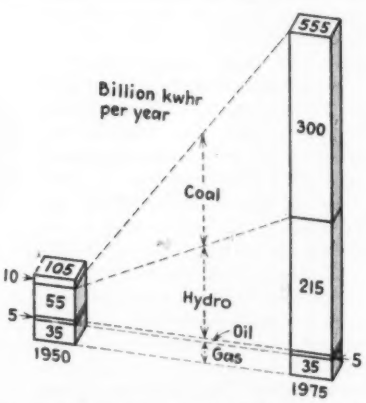




8 Diversity of peaks in relation to time zones makes saving in capacity possible with complete area network. Varying weather, temperature also reduce total peak

in the West. By 1975, they estimate that 47 million kw of this will be economically developed, compared to the 9.18 million existing in 1950. The Bureau feels that the oil and gas reserves, now decreasing percentagewise compared with tremendously increasing annual consumption, will not offer any increased economical energy source for electric generation by 1975. They foresee local oil- and gas-fired plants reserved for peaking and emergency duty. As a result, coal and lignite, Fig. 9, must produce the bulk of kwhr in 1975, with hydro generating most of the remainder.

Coal and lignite are the largest energy reserves we have in sight. A large



9 Both hydro and coal will carry added load, with coal taking major share

part of this lies in the West, Fig. 4. These solid fuels may serve multiple purposes. Present research has shown it possible to extract chemicals and oils from coal and lignite, leaving a char that could be burned for electric generation.

The Bureau does not estimate that direct solar heat, wind power, tides or nuclear energy will reach important commercial proportions for electric generation by 1975. (As an interesting sidelight, Detroit Edison Co has announced it is working on plans for a nuclear power plant, designs to be completed this year. It feels nuclear production will be competitive with present methods. Construction depends on Congressional approval.)

Energy Transportation. Fig. 3 shows the comparison of kwhr needed by each watershed area in 1975 with the generation that could be produced locally. The major problem lies in choosing the most economical method of transporting energy from the coal-rich states to the high-demand areas. Should the coal and lignite be transported by rail to high-demand regions and burned in steam plants there, or should the fuel be burned in mine-mouth plants and electric energy delivered over high-voltage transmission lines?

The three major deposits of solid fuels are about 400 to 660 miles from the five energy-deficient areas. The Bureau study concludes that for the longer distance, energy can be transmitted in bulk at 500,000 volts for about 1.86 mills per kwhr. They compare this with a figure of 2.19 mills per kwhr for transportation in the form of coal by rail.

The fixed-charge rate of 5.6% for substations and 4.75% for transmission lines used by the Bureau disagrees widely with rates, from 10 to 15%, that private utilities would use. This reflects the subsidy that government-built projects enjoy. The higher fixed-charge rate would make electric transmission more costly than coal transportation. This phase of the study is largely academic, however, since comparative costs can change radically in the next 22 years. It may be likely that a combination of the two methods of energy transport will prove most economical by 1975.

The Bureau states, "No doubt, elements of the system will be constructed by various power agencies operating in the area, both public and private." Prime value of the study lies in revealing the exciting possibilities of expansion during the next quarter century and indicating one course of development that might be followed. Fig. 5 shows the outlines of a 500-kv transmission-line network that the Bureau envisions for the future.

Large steam plants with capacities of 1.5 to 2 million kw would be located in the coal fields. Units of 300,000-kw capacity would be used to make up the station capacity. Power from several large plants would probably be brought to central substations for transmission over the high-voltage lines. Several parallel lines would be needed to carry the energy. Substations in the load areas would step down the voltage for distribution.

Experimental high-voltage lines show them to be feasible. Principal trouble lies in radio interference. While at the moment no satisfactory solution is in sight, probabilities are the problem will be licked.

Network Advantages. At times a network or integration of power systems may be difficult to justify solely on economic grounds. Other features may sway the decision to integrate. A network increases continuity of service. Improved flexibility may reduce operating costs by allowing fuller use of hydro power as it becomes available at a saving in fuel burned.

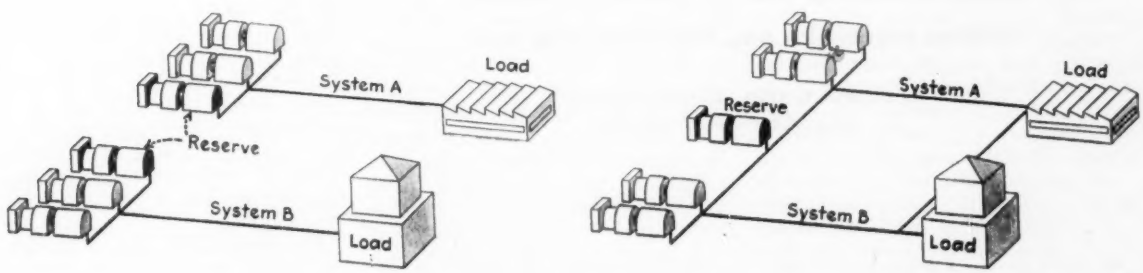
A network covering a large area saves in generating capacity by having a lower total peak load than the sum of the peaks on individual parts of the system, Fig. 8. This peak diversity in our case partly stems from the difference in time occurrence of darkness. Other factors contributing to increased diversity would be difference in local temperatures and weather over such a far-flung region, variations in local habits and others.

Integration makes a direct saving in capacity because of the reduced reserve needed, Fig. 10. Considering the simple case of systems *A* and *B*, the same reserve each requires for independent operation will do for combined operation since outages on the separate systems would hardly ever occur simultaneously.

CORRECTION

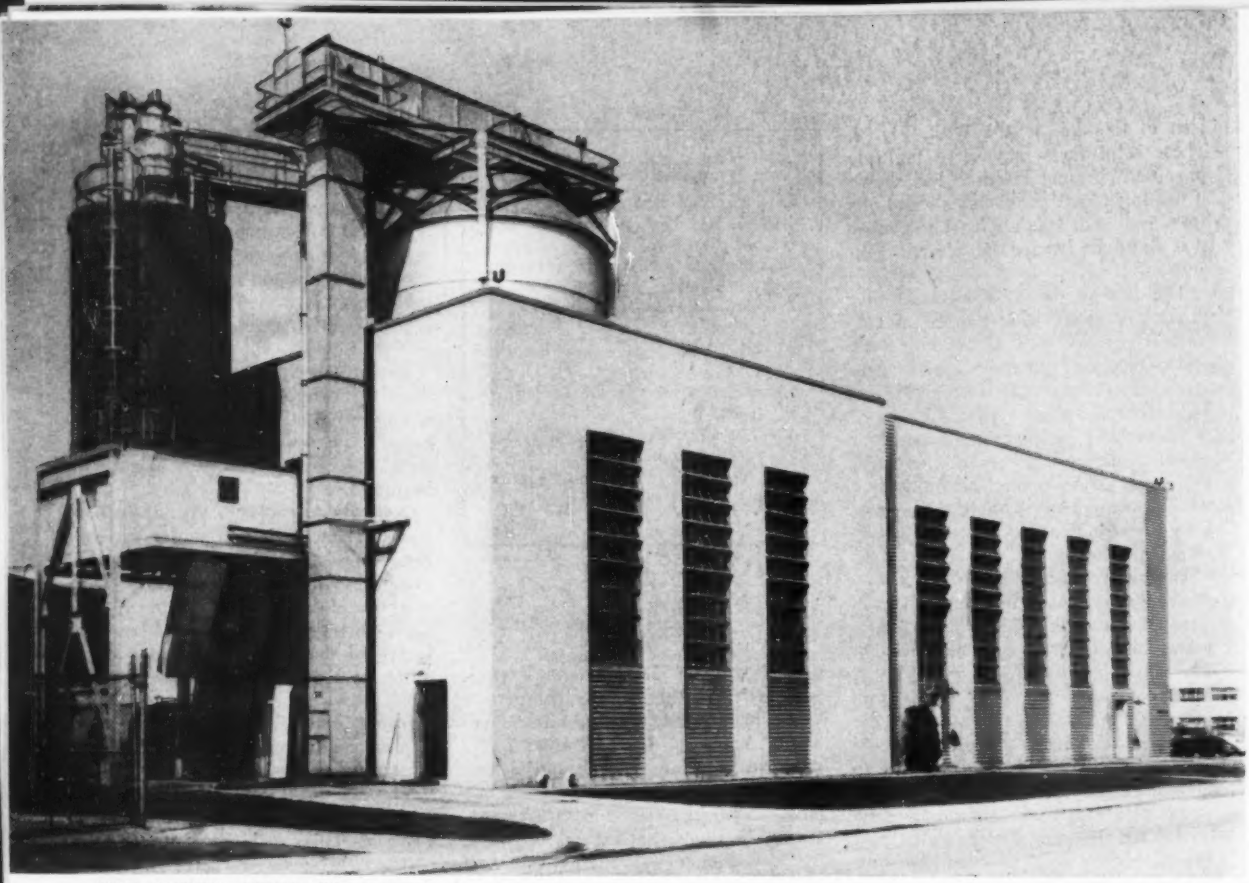
In the special report on GAS TURBINES, Dec 1952, p 106, identification of "Builders," bottom of page, is in error. Beginning with first item below it should read:

C—Clark Bros Co, USA, (not Elliott as shown)
E—Elliott Co, USA (not English Electric, as shown)
EE—English Electric Co, Ltd, England
El—Elsinore Shipbuilding & Engrg Co, Ltd, Denmark
EM—Cie Electro-Mecanique, France
EW—Escher Wyss, Switzerland



Combining Power Systems Saves on Reserve Capacity

10 When two adjacent systems supply separate loads each must carry its own reserve capacity. When systems are interconnected, reserve for one system will do for both combined, as forced outages seldom occur at same time on both elements



THIS HIGHLY ATTRACTIVE street-front boilerhouse reflects the wise selection and good integration of five different steam generators put in over a period of years. They are equipped to handle the entire gamut of fuels—from solid to gaseous

Widest Possible Fuel Flexibility

Twin jobs of supplying ample steam for growing load and doing it at lowest possible cost were solved by (1) planning new boiler capacity in advance and (2) providing flexible facilities suitable for gas, liquid and solid fuels

By **GEORGE G REED**, *Mechanical Engineer*
Lewis Flight Propulsion Laboratory

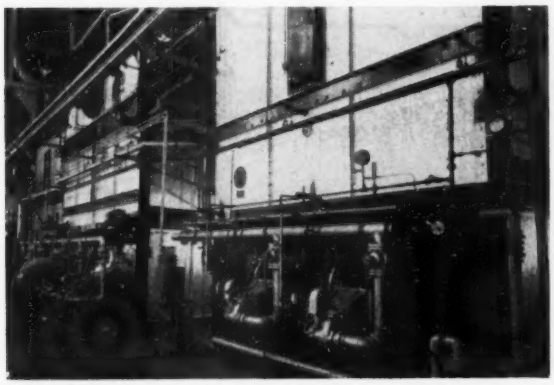
► LEWIS FLIGHT PROPULSION LABORATORY of the National Advisory Committee for Aeronautics, near Cleveland, has been growing like Topsy. Along with that growth there has been an accompanying appetite for more and more steam, as you might expect.

The boiler plant was originally designed for and served only three buildings. At the latest count Building No. 27 had just been completed. Fortunately size and capacity of the steam-generation equipment has been maintained a step ahead of the growth of the rest of the laboratory. What's more, despite so rapid an expansion program, the plant has emerged as a versatile, efficient layout with functional beauty, photo above.

Principal key to the plant's versatility is its available fuel-firing methods. They run the gamut from spreader-stoker units, top photo, facing page, to combination oil and gas burners, and to the gas alone, bottom photo. With this arrangement the major fuel can be the one that gives lowest over-all cost per lb of steam generated. For example, during the summer months when gas is plentiful this fuel carries the bulk of the load.

Fuel Storage. But back of this selection is an emergency coal supply of several thousand tons in the storage yard, plus a reserve of fuel oil in tanks. The laboratory has no railroad siding so coal comes in by truck loads of about 15 tons each. A bucket elevator, 50-ton-per-hr capacity, hoists coal up, then con-

SPREADER STOKERS handle steam load of two 24,000-lb-per-hr units equipped with dust collector, ash-handling system



GAS BURNER feeds only one 24,000-lb-per-hr boiler, next to two 16,800-lb-per-hr combination gas- and oil-fired designs

Principal Power-Plant Equipment

Lewis Flight Propulsion Laboratory, NACA, Cleveland

STEAM-GENERATING EQUIPMENT:

Boilers, 2 (24,000 lb per hr each, 100 psi, saturated, Type FF15-40)	Babcock & Wilcox Co
Boilers, 2 (16,800 lb per hr each, 100 psi, saturated, cross)	E P Keeler Co
Boiler, 1 (24,000 lb per hr, 100 psi, saturated, Type C P)	E P Keeler Co
Stokers, spreader, 2 (Hopper fed, Firite model)	Hoffman Combustion Engrg Co
Burners, gas & oil, 6 (Combination, gas and oil, In-A-Door design, 3 per boiler)	Combustion Equip. Div, Todd Shipyards Corp
Burners, gas, 2 (In-A-Door design, 2 per boiler)	Combustion Equip. Div, Todd Shipyards Corp
Fans, forced, 5	Clarage Fan Co
F-d fan motor—devices	Westinghouse Electric Corp
Fans, Induced, 5, fluid drive	American Blower Corp
I-d fan motor—drive	General Electric Co
Collectors, dust, 2	Breslove Separator Co
Spreader-stoker installations	Western Precipitation Corp
Coal handling	Beaumont-Birch Co
Ash handling	Chicago Fire Brick Co
Combustion control	Republic Flow Meters Co

WATER TREATMENT, PUMPING:

Deaerating heater, 1	Swartwout Co
Pumps, 3	Goulds Pumps, Inc
Boiler feed	McGowan Pump Div, Leyman Mfg Corp
	Peerless Pump Div, Food Machinery & Chemical Corp
Water treatment	Cochrane Corp

BUILDING AND ERECTION:

Boilers	Schafer Bros.
Piping steam	Feldman Bros.
Building addition	Hunkin-Conkey Construction Co

Gives Lowest-Cost Steam Output

veys it horizontally and discharges it to an overhead storage bin. This bin holds 200 tons. It is located so one part lies within the building to prevent any possible freeze-up. This shielded part contains enough coal for a long weekend.

A dustless roller-type gate removes the coal from this bin and feeds it directly into a floor-operated 2-ton weigh larry. The weigh larry, in turn, empties into the selected stoker hopper. This larry is electrically operated with a drum controller and has four speeds forward, and a reverse.

Ash Handling. A 30-ton glazed-tile storage bin, visible in photo on facing page, features the plant's ash-handling capacity. It is equipped with a rotary dustless unloader, a primary receiver and separator, and a venturi-type steam-jet exhauster. This equipment employs an 8-in. OD conveyor pipe with a 10-ton-per-day capacity, and a refractory-lined hopper under the spreader-stoker boilers to collect and remove ash. Ashes from the three remaining boilers when converted for spreader-stoker firing (see "Boiler Design" below) can enter the automatic ash-handling conveyor pipe through gratings on the floor.

Because Lewis Labs are for research purposes dust, flyash and smoke cannot be tolerated. The rotary unloader on the ash side has water sprays to keep ash disposal dust free. Flyash separators on the spreader stokers hold stack dust down to practical limits and effective combustion controls maintain excellent furnace conditions for complete combustion.

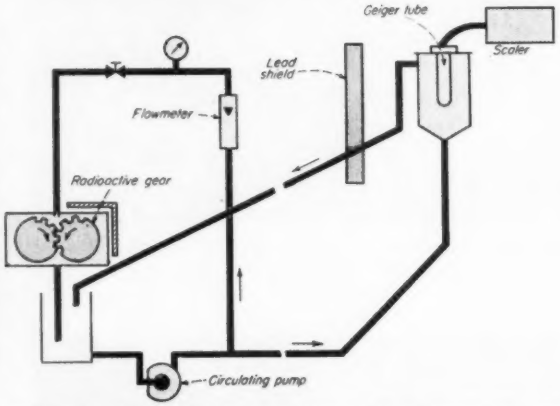
Boiler Design. Steam-generating plant consists of five boilers, see equipment table. Two 24,000-lb-per-hr units employ spreader stokers, two 16,800-lb-per-hr boilers have combination oil-and-gas burners, and one 24,000-lb-per-hr design has gas burners only. The last three have spreader-stoker grates. But they have been bricked over with a covering of Transite and firebrick, and left in place in the event they should ever need to be converted back to coal.

All steam, generated and distributed at 100 psi, goes for heating and process work. This 100-psi supply passes through piping carried in concrete tunnels, with removable slab tops. It then goes through reducing valves for use in individual buildings.

Water Treatment. City water with a hardness of 125 ppm enters the plant through an automatic zeolite water softener of 24,000-lb-per-hr capacity. The treated water then goes to the boiler cycle itself where further internal treatment takes place within the boiler. Causticity is held at 20 ppm with a continuous feed to the drum. Phosphate is supplied in slug treatments every 8 hr, the amount depending on hydrometer tests. The result of this water treatment has been troublefree service.

TEST MACHINE results based on metal transfer between surfaces separated by boundary film where test gear is radioactive

Geiger Tube in Path of Circulating



GENERAL TEST SETUP for gear lube study. Radioactive gear was exposed to 30-day neutron bombardment in atomic pile

Radioactive Gears Speed Lube Studies

This new technique, involving radioactive tracers, determines whether gears operate in hydrodynamic or boundary region*

► GEAR DESIGNERS have been steadily pushing toward lighter weight, heavier loading and higher speeds. And to match the pace, gear lubricants, which have the multi-facet job of cooling, score-prevention friction and wear reduction, have gone through an evolution. To date gear lube improvements include: (1) use of extreme-pressure (EP) lube additives to increase load-carrying ability without scoring (2) extension of lube's fluidity range (3) improved stability and use of additives to prevent corrosion and foaming.

Further on we will show how radioactive tracers are used in gear-wear study. But first let's probe deeper into this matter of gear failures and gear lubrication.

Gear failures fall into six classes: *tooth breakage, pitting, scoring, abrasion, chemical wear* and *corrosion*. Tooth breakage is a mechanical and fatigue phenomenon. It depends on load, number of cycles, strength of materials and tooth form. Abrasion and scoring (scuffing) indicate lube failure.

Chemical wear is met where EP-type additives are used in a lubricant to counteract scoring. EP additives react with gear-tooth surface to form a protective film not readily displaced. When this film does its job, a portion is lost, giving rise to further film-forming reaction and chemical wear. Usually, this wear is too slow to affect gear performance within equipment's normal life span.

Gear-failure problems are challenged through mechanical design by (1) improved gear materials (2) heat-treating processes (3) surface finish and (4) accuracy. Trend is toward a higher degree of smoothness to spread load more uniformly over contacting surfaces, minimizing peak loads at asperities (surface peaks).

Gear Lubrication. There are three approaches to producing lube films that broaden the region of boundary lubrication: (1) adding polar compounds to be adsorbed on the gear teeth (2) adding unstable materials to decompose and deposit a tough clinging film on gear surfaces — leaded oils (3) using compounds with chemically active ingredients like chlorine, sulfur or phosphorous (EP oils) to react with gear-tooth surface forming a high-load carrying film.

All these approaches have been effective in some application. First two are well suited to bronze on steel worm gears. For heavily loaded steel-on-steel gears the chemically active EP oils are the more successful.

Effect of overheating on the lubricant has been reduced by more careful selection and treatment of base lubricants, use of oxidation inhibitors and, for special applications, use of synthetics in place of mineral-base lubricants.

Foam, although of mechanical origin, has been reduced by additives. Corrosive problems are handled by avoiding additives that produce corrosive materials by side reactions.

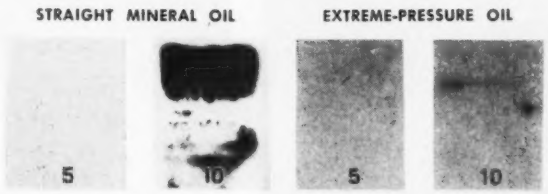
All together, these mechanical and lubricant improvements have meant sizable strides in the art and science of power transmission through gearing. Further progress will come when more data are available relating a gear's power-transmitting capacity to the physical and chemical characteristics of both gear and lubricant. First step in this direction calls for an understanding of the mechanism of gear lubrication.

Studies of journal bearing lubrication show there are two zones of lubrication: *hydrodynamic* and *boundary*. In the hydrodynamic or thick-film zone, lube is thick enough to prevent contact of even the highest asperities of the rubbing surfaces. Integrated film pressure over the bearing area equals the total load. In this lubrication zone, friction is low since we are dealing only with the friction within the fluid. There is essentially no wear since there is no contact between metal surfaces.

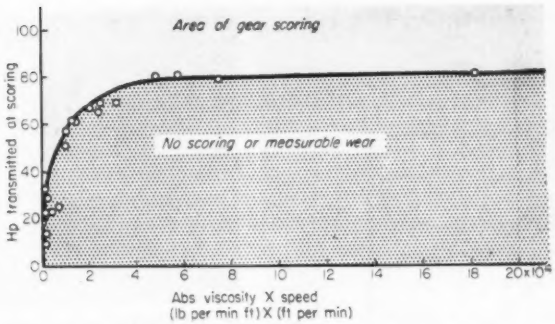
But when load becomes greater than hydrodynamic pressure can support, lubrication falls into the boundary or thin-

*A free adaptation of a paper by V N Borsoff and S S Sorem, Shell Development Co, Emeryville, Calif. presented in full at the fall meeting of the Association of Iron and Steel Engineers.

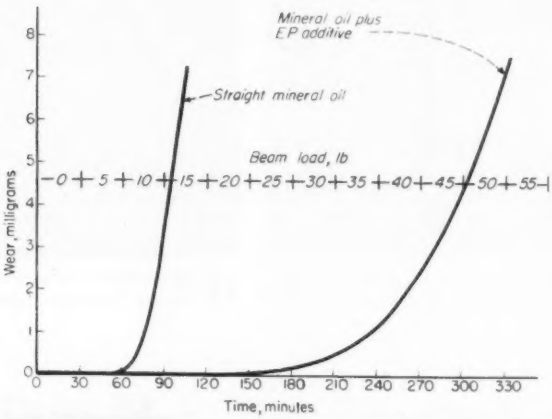
Lube Oil Indicates Wear of Radioactive Gear



AUTORADIOGRAPHS made by exposing film to inert gear teeth after gear has run against radioactive mate. Numbers show psi


Area of gear scoring
No scoring or measurable wear
Hp transmitted at scoring
Abs viscosity X speed
(lb per min ft) X (ft per min)
20x10⁶

GEAR SCORING TEST with straight mineral oil. Visual results indicate hydrodynamic lubrication exists in area below curve



RADIOACTIVE TEST data above, gathered with gear test rig on facing page, show how an EP additive will reduce gear wear

film region. Some of the load is then carried on films formed by adsorption or reaction of some component in lubricant with metal surfaces. There is a higher coefficient of friction and some wear in this thin-film zone.

Film Thickness. In what lubrication zone do gears operate? There are two schools of thought. One believes gears operate in the boundary zone and formation of a thick film is unlikely. The other recognizes thick-film lubrication in regions of light loads, and believes it is possible to extend the thick film even to extremely high loads. To consider both theories fully calls for knowledge of precise tooth-contact pressures and the supporting hydrodynamic pressures. And neither of these is readily determined. Here's why.

Hydrodynamic film pressure is a function of speed, fluid viscosity, density, and shape of surfaces forming the film boundary. Fluid properties vary with pressure and temperature. And the film boundaries may be significantly affected by elastic and thermal distortions and profile errors. Since the mathematical analysis is extremely involved, calling for many simplifying assumptions, the following empirical approach was made.

Let's look at the gear-scoring curve, left, obtained with straight mineral oil. Operating at any point above the curve means gear scoring. Operating below this line gives no scoring or measurable wear. This indicates hydrodynamic lubrication in the area below the curve. But a conclusion based on visual indications of wear is inadequate. Radioactive tracers have provided an answer besides being useful in study of gear wear in the presence of chemically active lubricants.

Radioactive Tracers. General test setup used is shown here. Gears are 17- and 19-tooth spur, six diametrical pitch, 20-deg pressure angle, ¼-in. face width. They are made of SAE 3312 steel and ground with an unmodified profile to about AGMA Class 4 tolerances.

The 17-tooth gears, weighing about 150 grams each, are made radioactive by a 30-day neutron bombardment in an atomic pile at Oak Ridge. Their activity 15 days after removal from the pile is about 250 milliroentgens per hour at one ft. Average half-life over the 30 to 60 day period is 90 days.

Remember, metal transfer takes place between surfaces separated only by a boundary film. When one surface is radioactive, metal transferred during operation under boundary conditions may be detected on the inert surface by its activity. Autoradiographs are shown above, made by exposing a photographic film on tooth surface of an inert gear after running against a radioactive gear. Oil *A* is a straight mineral, while *B* is a mineral oil with an EP additive.

Wear Measurements. To make wear measurements, a portion of oil from lube system is circulated through a chamber containing a Geiger counter and a scaler unit. Geiger tube is protected from heavy stray radiation by lead shielding around gearbox and between gearbox and Geiger chamber. A tooth broken from an active gear is mixed with oil to establish a measurable relationship between the scaler count and quantity of wear products in the test oil.

Next step is to take portions of this reference oil, containing known weights of gear metal, and add it to circulating-oil system. A calibration curve is then drawn.

Final value of gear wear is found after correcting for gear activity on day of test, relative to its activity on day of calibration.

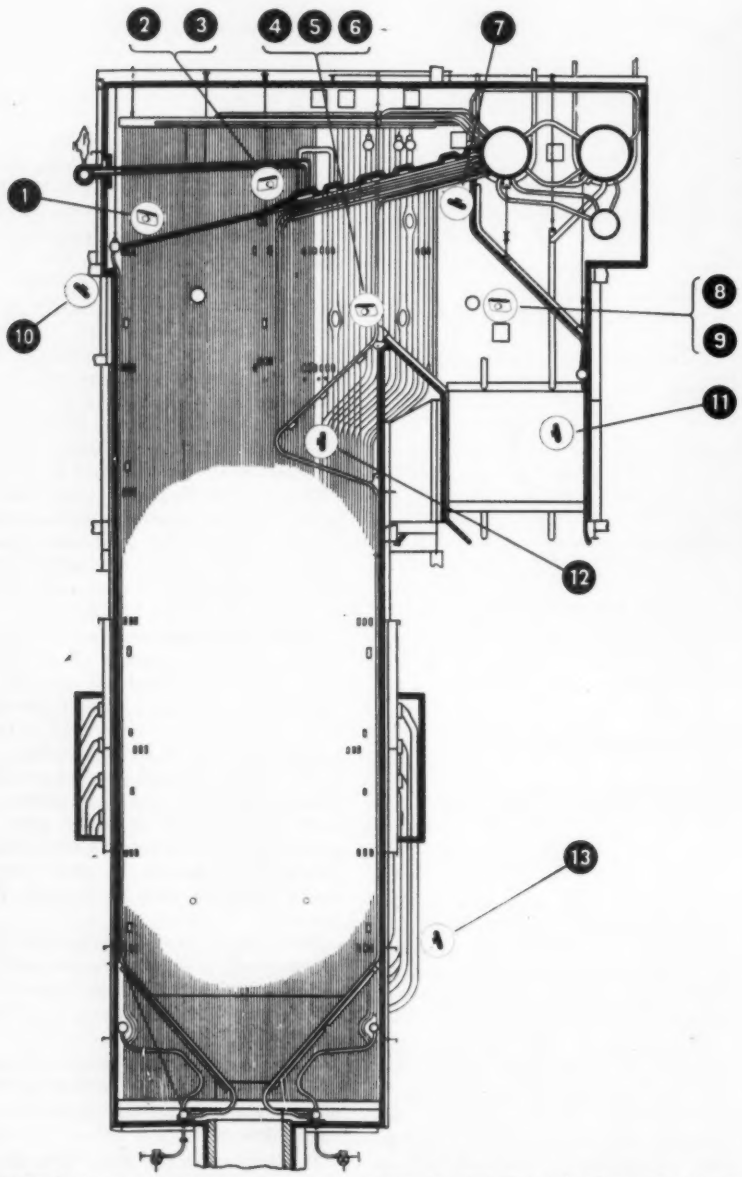
Check on test oils *A* and *B* showed no wear at any load below the hydrody-

(*Continued on page 214*)

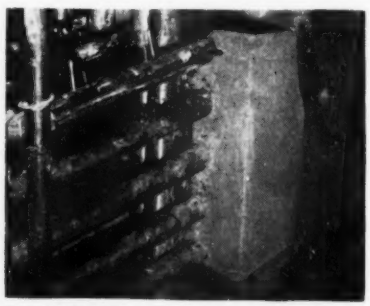
1 **FURNACE** roof gets 3½-in. cover of castable refractory laid over tubes

2 **PLASTICITY,** low firing shrinkage give tight heat-seal around hangers

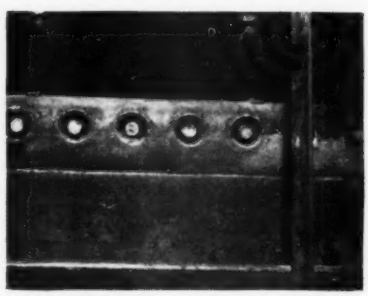
3 **MONOLITHIC** construction is fast, easy to apply, air-sets cement hard



BOILER develops 625,000 lb per hr at 1300 psi, 950 F for Montaup Electric Co, Somerset, Mass. Castable refractories are used for heat-facing surfaces throughout



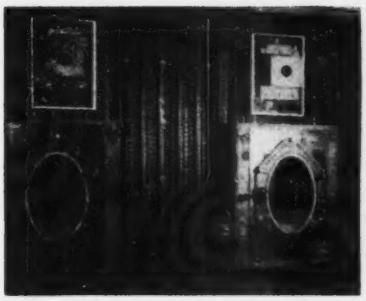
7 **CASTABLE** seal around drum leaves no cracks, stays tight after firing



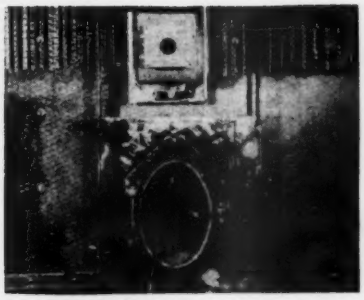
10 **ROOF-TUBE** header has castable seal for complete tight-spot closure

Monolithic

Castable refractories can be placed by trowel or poured in by bucket. They form complete walls and adapt to any shape, give tight seals and mature under fire. Resulting monolithic structure has strong bond and a long service life

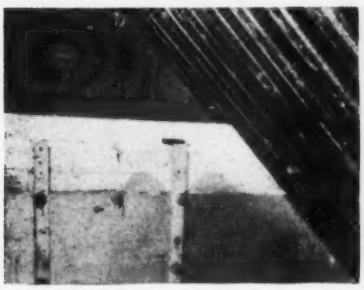


4 **FINNED** waterwall tubes with wire mesh ready for insulating castable

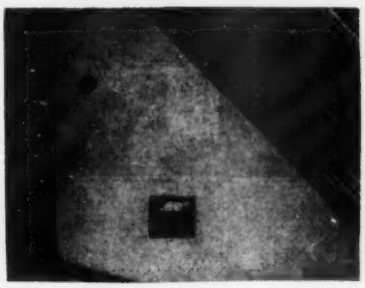


5 **REFRACTORY** is hand thrown through mesh on tubes, smoothed with trowel

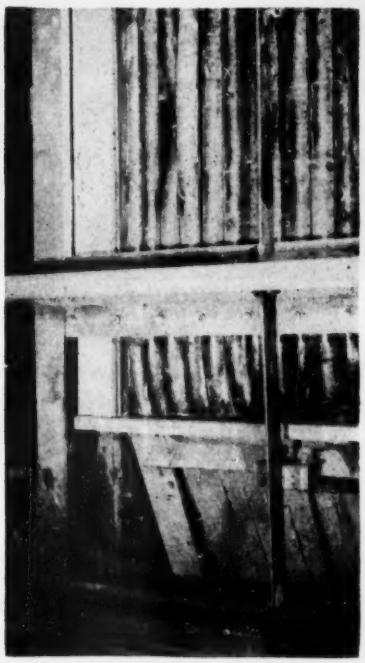
6 **FINAL** job is tight, seamless; has three layers of insulation on outside



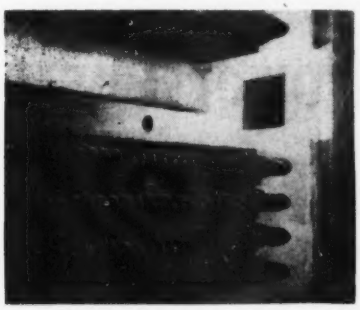
8 **INSULATION** and wood form in place ready for castable refractory layer



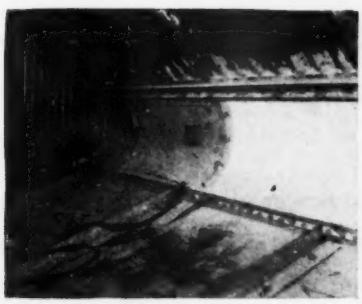
9 **COMPLETED** surface is 3-in.-thick, sectionally supported monolithic wall



13 **WATERWALL** tubes ready for mesh hanging, refractory in place below



11 **ECONOMIZER** banks are enclosed by walls faced with castable refractory



12 **CASTABLE** filler between irregular tube surface and smooth steel plate

Refractories Do Smooth Big-Boiler Job

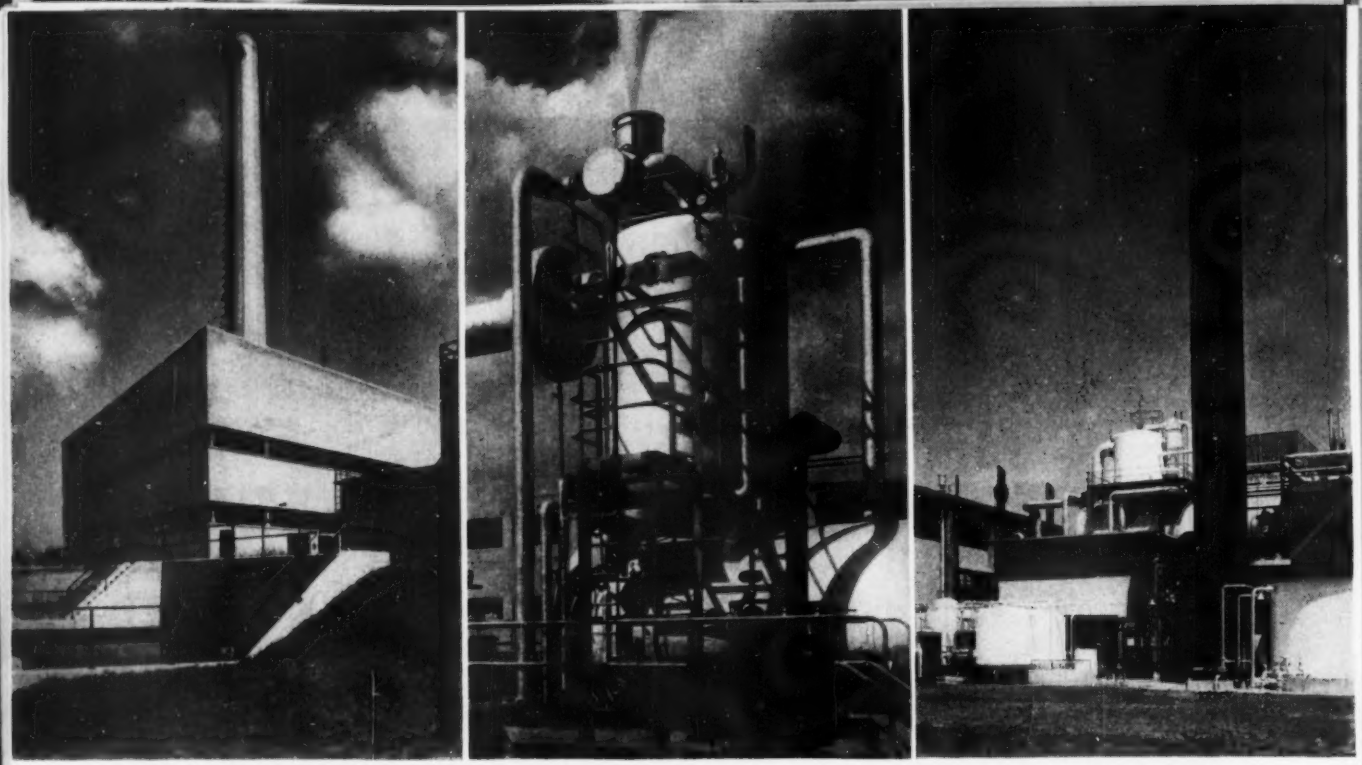
► MONOLITHIC refractory construction has been used in small boilers for at least 40 years. But the fact that it is also being applied to large central-station-size units is not too well-known in the industry. The pictures above show just such a job in the making.

The boiler, built by Combustion Engineering-Superheater, Inc, for the Montaup Electric Co at Somerset, Mass., develops 625,000 lb per hr, 950 F, 1300 psi superheater outlet. Stone & Webster Engineering Corp were the consulting engineers.

Castable refractory, supplied and installed by Plibrico Co, Chicago, Ill., is used as heat-facing material throughout radiant and convection passages of this large boiler. Successive layers of monolithic refractory, block insulation, 85% magnesia block insulation and plastic-insulation cover coat make up most of total heat-enclosing envelope materials.

Monolithic refractories are available in two forms: A castable type of dry composition is mixed with water, troweled in place or poured behind forms. A plastic type of stiff putty consistency is used directly from container, rammed in place. Both come in different grades to meet service conditions. Both fire to maturity in service operation.

Monolithic refractory surfaces can be supported on a wire mesh hung by studs welded to the backs of waterwall tubes. They can also be sectionally supported and anchored to structural steel or refractory walls. Monolithic suspended arches are as practical as the same construction used in vertical surfaces, and application includes air-cooled walls as well as the conventional solid brick wall construction.



CONSTRUCTION CHANGES represent greatest single area where power plants can reduce investment in face of rising costs

Industry's Experts Fight Power Costs

Because industrial power plants never follow a set pattern, worthwhile comparisons of their costs have always been scarce. Now big industry is tackling the job by trying to set up its own yardsticks

THE EXPERTS

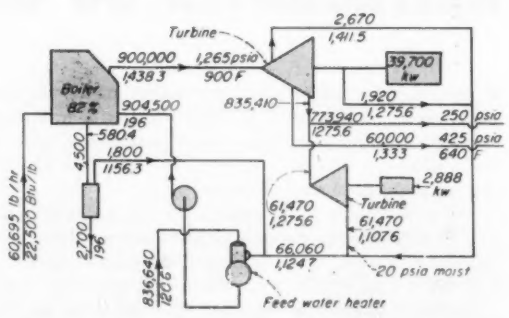
C S ROBINSON, Assistant Principal Power Engr
E I du Pont de Nemours & Co; ASME Paper 52-A-107, "Economical Industrial Power-Plant Design"

J CAMPBELL, Senior Power Engineer
E I du Pont de Nemours & Co; ASME Paper 52-A-109, "Investment Costs—Industrial Power Plants"

A D RUST, Engineering Consultant
Dow Chemical Co; Texas Div, ASME Dallas Section Paper, "Engineering of Power Plants for Process Industries"

T A FEARNSIDE, Mechanical Engineer
F C CHENEY, Electrical Engineer
Stone & Webster Engineering Corp; ASME Paper 52-A-108, "Industrial Power-Plant Construction Costs Since World War II" (co-authored paper)

Combining Process and Power Gives Best Economy



PROCESS power plants can combine power and steam. Figures shown above flow line are flow rates, below heat content

HERE'S HOW FIVE EXPERTS COMPARE POWER-PLANT COSTS

► ADEQUATE AND DEPENDABLE electric power is and has been pretty much the vital element in our industrial progress. Utility engineers have carried on much of the trail blazing. They've hung up an amazing record in reducing costs and increasing availability. The industrial power man has been doing an equally creditable job. But many of the major design factors take on a different economic perspective in his considerations.

As an example, the modern public-utility plant has a heat-rate range from 14,000 Btu down to 10,000 Btu per kwhr, or a thermal efficiency of 24 to 34%. Most of those plants with good heat rates are large ones of about 100 mw or more, have many stages of heating, and use high pressures and temperatures.

In the process-industry power plant, on the other hand, 10,000 Btu heat rates are not uncommon. If a good power cycle can be applied (see figure, facing page) you will get heat rates down to 4600 Btu per kwhr or a 74% thermal efficiency. A full-condensing, nonextraction plant of the utility type sees roughly two-thirds of its fuel Btu's go into the condenser and from there "down the drain."

A well-engineered job, everybody agrees, gives the lowest economical investment for the required facilities without sacrifice of engineering quality, excellence of finished product, or safety. To reach this ideal you need definite aids to keep your design as close to facts and as far from personal opinions as possible. You'll find habit often dictates certain preconceived ideas of what a new power plant should contain. The ideal start is a minimum of equipment, adding only those pieces that you can justify on the basis of an acceptable return. Unfortunately, industry has to add dust collectors and safety devices that do not improve operation, but do add markedly to investment.

Several engineering meetings have recently tackled this problem of the industrial-plant design. Out of them (see "The Experts," facing page) have come several good guides on costs, starting below, to help bridge the gap between the investment ideal of lowest possible costs and the operating ideal of a completely safeguarded, troublefree plant.

INVESTMENT VS OPERATION

Robinson: "You get the lowest possible investment together with a sound operating plant by following this code. Use fundamental engineering thinking plus firm basic data, including process demands, costs (both estimated and actual) materials, equipment, apparatus available. Then develop within your own organization talent that can educate your plant operators to accept departures from normal. As far as that goes, develop talent that can influence manufacturers to develop competitive equipment that better meets certain of your plant functions.

"Once past the background-knowledge stage, above, be certain all phases of a job are integrated, that the same philosophy follows for selecting all equipment and deciding on component parts such as steelwork, concrete. Just reaching a low unit-cost installation in $/lb/hr is pointless if you've designed for 20% more capacity than you need. You've spent about 20% more money than you should have."

Rust: "Second the motion on fundamental engineering thinking, plus the need for all known or calculated maximum and minimum process demands both present and future. It's often possible to change the design of some phases of the process plant and effect over-all savings. For instance, keep the number of steam pressures supplied to process down to two or three. Remember, fuel costs are rising at an accelerating rate, and indications point to more of the same. So it is necessary for process-plant engineer and power-plant design engineer to cooperate in using steam and power in a way that lays stress on fuel economy. The economy-minded designer will bear in mind that larger units have lower costs per kw or per pound of steam.

"For example, a 2500-kw turbine with two automatic extraction points costs about $74 per kw against $43 per kw for a 25,000-kw turbine equal in every way. Boiler costs vary in about the same ratio. These figures are 'delivered only' but foundation, erection, accessories should be compared in the same way (*Editor's note: see table IV*). The cost of power plants for process may be expected to vary from $100 to $300 per kw of capability rating. The variables are many—condensing or backpressure units, Table II, cost of turbogenerators, boilers, number of pressure-reducing and desuperheating stations, feeder buses and circuits, how

I. Heat-Rate Calculation for Process Power Plant From Heat-Balance Diagram Shown in Figure at Left

Output steam		Btu per hr
250 psia	773,940 lb per hr	987.24×10^6
425 psia	60,000 lb per hr	79.98×10^6
	Total	1067.22×10^6
Input Water	836,640 lb per hr	100.90×10^6
	Total	966.32×10^6

$\frac{966.32 \times 10^6}{0.82} = 1179.37 \times 10^6$ Btu involved in process-steam production

Input gas	60,695 lb per hr at 22,500 Btu	1365.64×10^6
Btu to process steam		1179.37×10^6
Btu to production of power		186.27×10^6

$\frac{186.27 \times 10^6}{42588 \text{ kw}} = 4374$ Btu per kwhr, gross

Correction for auxiliaries

$\frac{4374}{0.95} = 4604$ Btu per kwhr, net • Thermal efficiency $\frac{3412.75}{4604} = 74\%$

II. Gains Comparison—Condensing and Backpressure Cycles Assumption; 200,000 Lb per Hr Steam Flow

	Theoretical WR/kwhr	Kilowatt generation	Gain kw	Gain percent
Condensing				
Initial conditions				
400 psi, 750 F ½ in. Hg	7.14	28,011		
Second conditions				
850 psi, 850 F 1½ in. Hg	6.312	31,685	3674	13.1
Backpressure				
Initial conditions				
400 psi, 750 F 100 psi	23.86	8,382		
Second conditions				
850 psi, 850 F	15.48	12,920	4538	54.1

Note: Figures are based on theoretical water rates; in practice, difference in favor of backpressure unit is greater than shown.

much of the distribution systems, both steam and electrical, are charged against the power plant or the process."

INVESTMENT COSTS

Robinson: "We cannot talk intelligently about low cost unless we have sound cost data. The old unit of $/lb/hr of capacity installed has no meaning because you have to guess on the split wherever you have turbine rooms as well as boiler rooms. Here's what we did to get a comparison. We brought together the unit costs of a number of boiler-houses started up from Nov 1939 to March 1943, see chart, below, to guide us when we wanted to install a 200,000-lb-per-hr pulverized-coal-fired boiler at Belle. Column *A* shows accumulated investment in boiler house prior to the new boiler with book values adjusted to the then current construction index of 300. Column *B* covers the estimated cost of a new boiler, Column *D*, the combination of *B* and *C*, and Column *E*, *F* and *G* unit costs for other similar commercial plants, all adjusted to the construction index of 300. The other two columns, *H* and *I*, are composite costs; *H* of these three plants and *I* of seven war plants built in the same period, and brought up to 1949-1950 costs by use of the construction index for that period—520.

"Table IV tabulates estimated and actual unit costs for the Chattanooga and May plants built during 1949-1950. Here costs are adjusted to the then current construction index of 520. Column 1 gives actual cost of two 40,000-lb-per-hr boilers that went in at Chattanooga, Columns 2 and 3, the estimated and actual costs for a third boiler at this same plant, and Column 4, the average for all three. Columns 5 and 6 cover the May plant installation. Actual cost means final complete design and construction charges. These figures could be plotted directly on the chart, below. You'll note the 1939-1943 plants adjusted to 1949-50 levels would cost $11 or more per lb per hr whereas Chattanooga is down around $8/lb/hr, and the May plant less than $6.50/lb/hr.

"These last two plants are small boiler jobs. The 1939-1943 plants had boilers of 150,000-lb-per-hr rating in almost every case. We feel our close adherence to the guides we mentioned above let us beat the accepted rule that unit costs for smaller boilers run higher than for larger ones."

Campbell: "To get better cost data than the above we set up a classification system where we segregate groups of related equipment. At present the classification covers only items within the boiler-house structure itself, Table III. But it gives sharp comparisons on the relative costs of the major item classes. For example, Plants *D* and *H* have the highest steam-generator cost but the lowest building. Both, as you'd expect, are in the South with much of the equipment outdoors. Piping in Plant *F* runs very low. The reason is simple. It's a small oil-burning plant with a relatively short distribution system.

"In Table III, steam generator means boiler, furnace, fuel-burning equipment with accessories attached or considered a part of these facilities, plus draft and dust-collecting equipment. Foundations, supports, drives, and other direct auxiliaries are included unless specifically listed in other categories.

"Boilers prove the largest single item in this classification. So we do everything possible to hold their investment costs down. In the first place, standard boilers offer the most immediate savings. Then we study summer and winter peaks so we can load all boilers during the winter and yet have one boiler off the line during the summer so each boiler can receive an annual inspection and overhaul.

"As steam demands increase we have sought ways of removing boiler-design bottlenecks. In one case with manufacturer cooperation we upped the capacity by 10% with only minor changes. As a rule we never buy boiler capacity in excess of indicated loads. We may get a boiler designed to receive superheaters, but they'll never go in until superheated steam seems a definite economic advantage. The same thing holds for auxiliaries. We buy to meet start-up conditions only, unless future increases in pressure or temperature are definite possibilities.

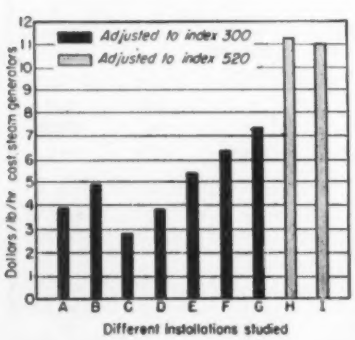
"Packaged boilers carry a strong appeal. They can be easily removed and used elsewhere as their original load outgrows them.

"Fuels are always a prime consideration. In addition to the usual fuel

(*Continued on page 206*)

III. Percent Breakdown of Major Elements in Power Plant

Plant	No. boilers, capacity of each	Fuel	Steam generator	Fuel handling	Dust and ash handling	Feedwater	Piping	Elect inst control	Bldg
A	3: 40,000	Coal	34	11	6	9	18	7	15
B	1: 150,000	Coal	31	7	2	9	16	8	27
C	2: 50,000	Coal	33	7	5	9	14	5	27
D	2: 45,000	Coal	41	14	11	6	12	6	10
E	1: 80,000	Oil	37	2	—	10	24	5	22
F	1: 8,600	Oil	27	8	—	19	7	2	37
G	2: 60,000	Gas	40	—	—	12	16	7	25
H	6: 180,000	Gas	47	—	—	15	19	7	12



COMPARISON of costs for 1949-1950 vs 1939-1943 shows benefit of planning

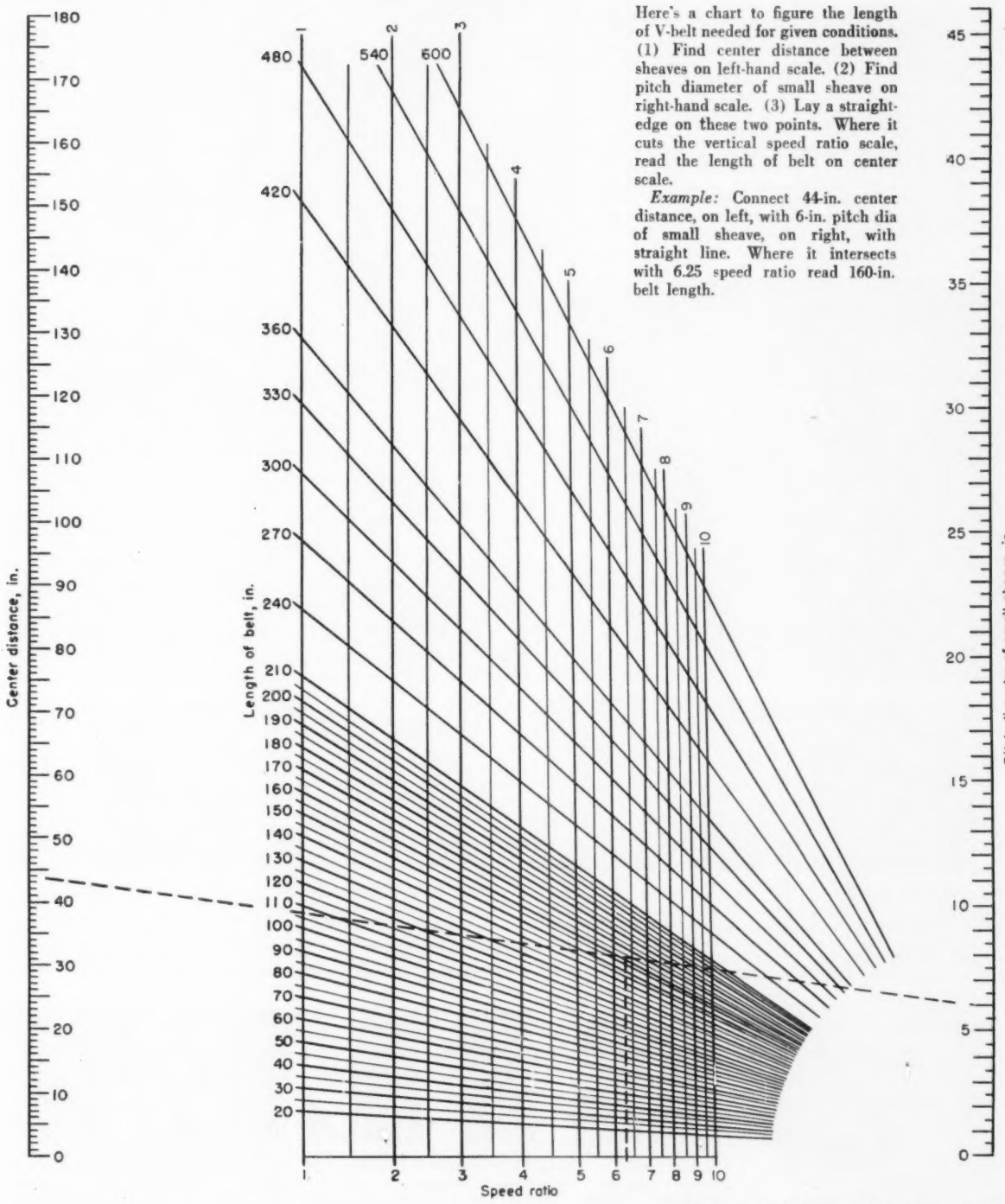
IV. Low Economical Power Investment, Dollars/Lb/Hr

	Chattanooga				May	
	2—40,000	1—40,000		Average of 3	2—45,000	
Index 520	Actual	Estimated	Actual	Actual	Estimated	Actual
Steam generator	2.75	2.74	2.52	2.67	2.38	2.62
Fuel handling	1.19	.39	.25	.88	.64	.88
Dust and ash handling	.53	.45	.38	.48	.56	.73
Feedwater	.79	.14	.13	.57	.47	.39
Piping	1.62	1.72	2.34	1.56	.85	.76
Electric	.36	.29	.24	.32	.19	.10
Instruments and control	.24	.39	.37	.28	.17	.29
Building	1.60	.99	.75	1.32	1.40	.67
Miscellaneous	—	—	—	—	—	—
Total net	—	—	—	—	—	—
Distributive	—	—	—	—	—	—
Total	9.08	7.11	6.98	8.08	6.66	6.44

Approximate Length of V-Belts

Here's a chart to figure the length of V-belt needed for given conditions. (1) Find center distance between sheaves on left-hand scale. (2) Find pitch diameter of small sheave on right-hand scale. (3) Lay a straightedge on these two points. Where it cuts the vertical speed ratio scale, read the length of belt on center scale.

Example: Connect 44-in. center distance, on left, with 6-in. pitch dia of small sheave, on right, with straight line. Where it intersects with 6.25 speed ratio read 160-in. belt length.



Courtesy, Allis-Chalmers Manufacturing Co

© POWER

What has caused this tremendous SWING to Riley Traveling Grate Spreader Stokers?

As more and more Riley Traveling Grate Spreader Stokers have been placed in operation Riley Spreader Stokers are being selected by greater and greater numbers of the country's leading public utility and industrial plants—to such an extent that Riley sales in 1952 were more than four times 1950 sales and fifty per cent greater than in 1951 though total boiler and stoker industry sales were appreciably lower.

We believe the fundamental reason for this tremendous swing to Riley is that news of the excellent results and satisfactory performance of Riley Spreader Stokers has traveled rapidly from plant to plant. Such satisfactory performance is largely due to design characteristics and the vast experience of Riley in the stoker field.

Minnkota Power Cooperative, Inc
Grand Forks, North Dakota
Two Riley Traveling Grate Spreader Stokers

THE GRATE SURFACE The grate surface is made up of small clips, two inches wide by six inch pitch, mounted on structural T bars. The use of small grate clips eliminates warping and cracking and assures low maintenance and long life by providing adequate cooling. Clips are of nickel-chrome alloy to minimize growth. A level grate surface and uniform air distribution results.

THE FEEDER-DISTRIBUTOR The feeder is designed to give uniform positive feed regardless of coal characteristics and moisture. Avalanching with fine coal does not occur. The overthrowing distributor gives uniform longitudinal and lateral distribution and prevents damage and outage caused by wedging of foreign materials between distributor and housing.

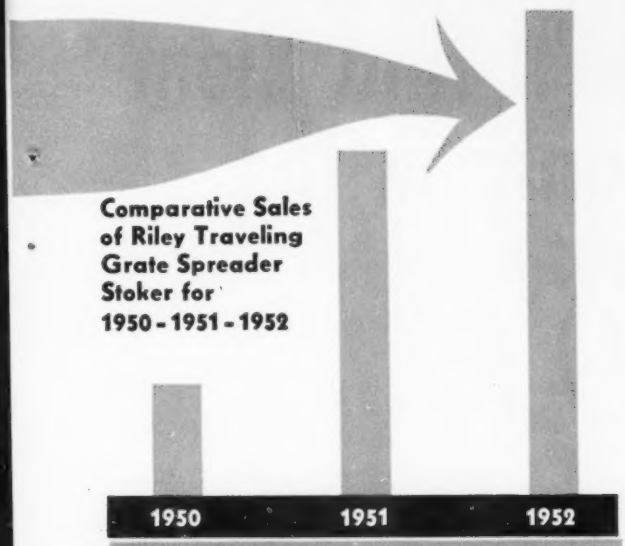
TRADE MARK Rx REGISTERED

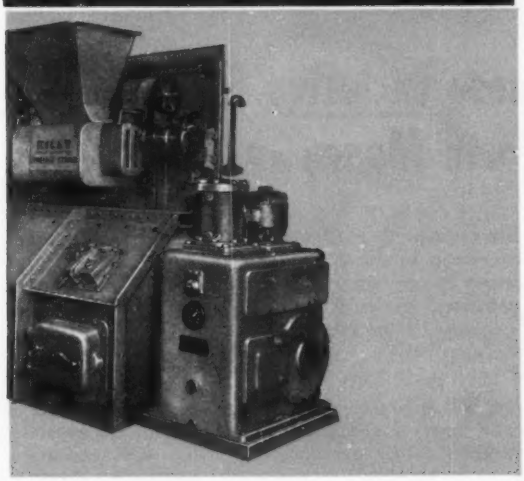
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Charlotte · Atlanta · New Orleans · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS





All of these Companies have ordered Riley Traveling Grate Spreader Stokers

Montana-Dakota Utilities
Mandan, North Dakota

Upper Peninsular Power Co.
Houghton, Michigan

Bendix Aviation Corp.
South Bend, Indiana

Hawaiian Commercial & Sugar Co.
Maui, Hawaii

General Motors Corp.
Saginaw Steering Gear Div.
Saginaw, Michigan

White Pine Copper Co.
White Pine, Michigan

Electrica De Bogota
Bogota, Colombia

Ohio Edison Co.
Youngstown, Ohio

City of Painesville
Painesville, Ohio

Carbide & Carbon Chemical Company
Whiting, Indiana

Ohio Edison Company
Springfield, Ohio—two orders

Iowa-Illinois Gas & Electric Company
Iowa City, Iowa

Celanese Corp. of America
Hopewell, Virginia

Cliffs Power & Light Company
Ishpeming, Michigan

Iowa Public Service Company
Carroll, Iowa

Kennecott Copper Company
McGill, Nevada

General Electric Company
Richland, Washington

Garlock Packing Company
Palmyra, New York

Swift & Company
Baltimore, Maryland

E. I. DuPont de Nemours & Co.
Savannah River Project, South Carolina

Kaiser-Frazer Company
Willow Run, Michigan

B. F. Goodrich Company
Akron, Ohio

Utah-Idaho Sugar Company
Washington

Armstrong Cork Company
Lancaster, Pennsylvania

Pennsylvania Electric Company
Seward, Pennsylvania—three orders

Ohio Edison Company
Youngstown, Ohio

Ottertail Power Company
Crookston, Minnesota

Champion Paper & Fibre Company
Canton, North Carolina

Central Illinois Light Company
Springfield, Illinois

Monsanto Chemical Company
Springfield, Massachusetts

General Electric Company
Louisville, Kentucky

Gaylord Container Company
Bogalusa, Louisiana

John Deere & Company
Alladin, Iowa

Swift & Company
Charlotte, North Carolina

Brown-Lipe-Chapin Div.
General Motors Company
Elyria, Ohio

U. S. Gypsum Company
Oakfield, New York

Stokely Foods
Indianapolis, Indiana

Catalytic Construction Company
Fernald Project, Ohio

Sangamo Electric Company
Springfield, Ohio

University of Minnesota
Minneapolis, Minnesota

Rochester Municipal Plant
Rochester, Minnesota

City of Napoleon
Napoleon, Ohio

Corn Belt Power Co-op.
Humboldt, Iowa

U. S. Air Force Base
Limestone, Maine

City of Ames
Ames, Iowa

Alabama Electric Co-op.
Andalusa, Alabama

Minnkota Power Cooperative, Inc.
Grand Forks, North Dakota

Spokane Water Works
Spokane, Washington

THE GRATE DRIVE The Riley grate drive is a hydraulically driven ratchet drive, completely enclosed and automatically lubricated. This simple rugged drive operates with practically no maintenance and is not susceptible to damage in case of grate obstruction. No sprockets, chains or speed reducers are required.

BACKED BY OVER 50 YEARS OF EXPERIENCE There are over 50 years of stoker designing and manufacturing experience back of the Riley Traveling Grate Spreader Stoker, dating back to the two first successful makes of stoker—the Murphy Furnace and the Jones Underfeed Stoker. Riley has been manufacturing traveling grate stokers for over 30 years.

We believe it will pay you to visit some installations before purchasing traveling grate spreader stokers.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

You'll find them only in the

JOY WG-9 COMPRESSOR

These Exclusive Features are worth Money to you!

Only the JOY WG-9, in its class, offers replaceable crosshead guides and cylinder liners, and full force-feed lubrication—features that will save you money in operating and maintenance costs. Unique truncated pistons and angled over-size "Dual-Cushion" valves assure higher valve capacity, better heat dissipation, lower air friction and elimination of valve pounding.

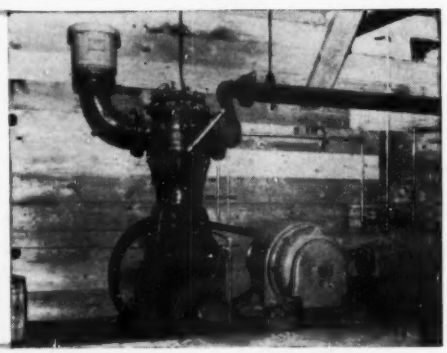
The WG-9 is a water cooled, double acting, single stage, heavy duty compressor for use where medium amounts of air are needed or for supplementary service in high air-requirement industries. Vertical design minimizes vibration and cuts required floor space. Foundation is but a simple concrete pad.

15 SIZES • 30 to 150 lbs. psi • 172 to 881 CFM

Consult a Joy Engineer

JOY COMPRESSORS Meet any Need

High and low pressure compressors, oil free compressors, boosters and vacuum pumps—Joy builds a type and size for every need. • Let us handle *your* air-supply job.



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A **Power** practical manual

HARD SURFACING

By STEVE ELONKA, *Associate Editor*

The difference between a new piece of equipment costing thousands of dollars and one that's ready for the scrap heap is often no more than a few pounds of metal worn or corroded from critical places. By applying tough alloys at spots that take a beating, we can lick these losses.

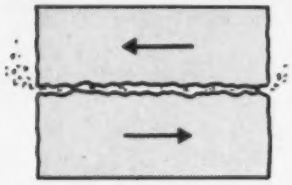
Hard surfacing, as this particular way of "saving the surface" is known, was never more valuable than today, when costs are high. Used in the manufacture of new products, it boosts working life many times. Perhaps even more important, hard surfacing is a potent weapon for cutting maintenance costs.

Not only can hard facing restore worn parts — it can give them a life expectancy far greater than that of untreated new ones. And every day, it seems, makers of hard-facing equipment and alloys come up with new methods and materials for better jobs.

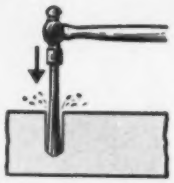
Here's what you need to know to cash in on this timely cost-cutting method — what hard facing can do, how to put it to work in your plant.

PLANT OPERATION and MAINTENANCE SECTION
MARCH 1953

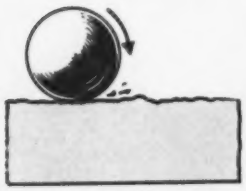
METALS WEAR IN MANY DIFFERENT WAYS



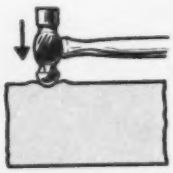
1 ABRASIVE WEAR



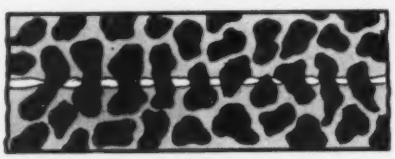
2 IMPACT WEAR



3 IMPACT AGAIN



4 MORE IMPACT



5 SCRATCH ON TUNGSTEN-CARBIDE ALLOY

HARDNESS TESTER: Rockwell type forces diamond cone point into metal. Gage shows hardness as indicated by depth of dent

Wear...and What You Can Do About It

We talk about "hard" facing to fight wear, and *hardness* is certainly a key factor. But there's more than one kind of wear and more than one way of licking it. And so before getting into the business of applying wear-protective surfaces, let's take a look at both wear and hardness—what they are, how they tie together, other things to remember.

WEAR

Abrasive wear is caused by one material scratching another. This happens when two materials of different hardness slide over each other, Fig. 1. A burr on a steel shaft, for example, scratches a groove in softer babbitt or bronze bearing metal. And, of course, the shaft wears a little, too.

Galling often occurs when two metals of about the same hardness rub together without lubrication. Good example is placing a steel pin in a steel hole. If pin fits tightly and isn't lubricated, it may stick in hole because of "cold" weld. Forcing pin out leaves some metal pulled out of hole's wall, "welded" to the pin, which shows up as galling.

Impact wear takes place when one material strikes another. A steel star drill wears a hole in granite because the tiny granite particles are loosened by constant impact when drill is driven against granite, Fig. 2. By turning drill slightly after each blow, the tiny granite particles keep loosening, thus deepening the hole. Same thing happens when steel balls revolve on granite under pressure, Fig. 3. But if the star drill in Fig. 2 is revolved by an electric drill instead of being hammered, wear is abrasive, and mainly on drill.

Hard materials resist abrasive wear. For example, sand wears soft metals very quickly. Under the same conditions, sand wears hard metals slowly.

Hardness Isn't All. You can't rely entirely on hardness comparisons as a measure of wear resistance. A piece of hardened steel may give a higher hardness reading than a deposit of the tungsten-carbide type, for example. But the latter resists wear better. Why? Tungsten-carbide alloy consists of almost diamond-hard carbide particles in a softer steel matrix. Most measuring methods give an average of the two hardnesses. But when it comes to actual wearing action, say by quartz, quartz will cut groove across soft steel matrix but slide over vastly harder carbide particles, Fig. 5.

What's Underneath? Properties of the surface play the biggest part in resisting abrasive wear. But resistance to impact wear is more than skin deep. You need a tough material to absorb the shock, or one that "gives" enough to distribute high compressive loads. Rubber, for example, may be superior to some metals. It cushions the blows, spreads the effects over a wider area. Final unit load is low enough to leave the rubber unharmed.

The same thing is true with ductile metals. A blow or a compressive load deforms the metal, spreads the stress without exceeding maximum strength, as on a less-ductile metal, Fig. 4.

Corrosion. So far, we've been talking about what might be called mechanical wear. Corrosion is electrochemical in nature, and pretty complex to boot. Yet

ABRASIVE WEAR takes toll of coal-feeder screw (look under welder's elbow). Hard facing with an alloy of high abrasion resistance will keep screw on the job longer

VALVES: 1500 hr in same diesel leaves hard facing, lower, unworn

PINION GEARS. Two stages: Worn at right and hard faced at left. Next step is machining

its net effect is a loss of material from the surface and it causes the same kind of maintenance headaches as abrasive and impact wear. Since it's a surface problem, you can cure many of these headaches by protective surfacings. Many hard-facing alloys contain chromium, which builds corrosion resistance. Where corrosion is the chief problem, there are some special alloys, like the stainless-steel types, which contain both chromium and nickel.

HARDNESS

We've mentioned hardness many times, but we haven't really defined it. Trying to is a good way to start an argument. Resistance to indentation, deformation, cutting, scratching, etc, all fit into the picture. For most practical purposes, we use either resistance to indentation or to scratching to measure hardness.

Brinell Test. Metals are usually tested by indentation, and Brinell method is probably most widely used. A hardened steel ball is forced into metal at a given pressure, Fig. 6. Width of depression is measure of hardness.

Rockwell Test. Because the Brinell ball deforms on very hard surfaces, it has limits. Rockwell tester uses a diamond cone on *C* scale, ball on *B*, Fig. 7. Degree of hardness, as indicated by depth of depression, is read directly from circular scale on gage, photo. Tester has two scales: *C* for hard metals, *B* for softer ones.

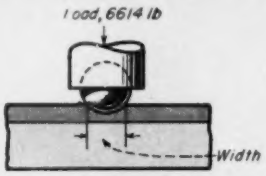
Scleroscope. In this tester, a weight with a hard round end falls 10 in. through a vertical glass tube. Height of rebound from sample is a measure of hardness. Tube is marked with a 140-part scale: 130 on scale is hardness of glass, hardest steel runs about 110.

Moh's Scale shows scratch hardness, with ten minerals as standards. But steps in scale aren't equal. Difference between No. 9 (corundum) and No. 10 (diamond) is about as great as between No. 1 and No. 9.

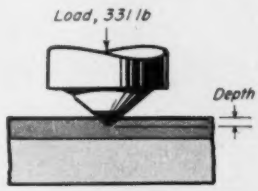
Handy Field Test. It's not usually practical to make real hardness tests while doing maintenance welding. But you can use the file test, see chart, up to about 500 Brinell, which is about 50 Rockwell C. Use a new machinist's hand file, exert steady pressure on file against metal with both hands.

Conversion chart, right, gives a good idea of equivalent values on the several hardness scales. Comparison isn't exact, and conversion charts differ, because metals aren't uniform and react differently to each test method.

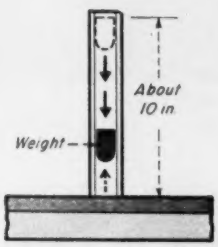
COMMON HARDNESS TESTS



6 BRINELL TESTER



7 ROCKWELL TEST



8 SCLEROSCOPE TEST

HARDNESS-SCALE EQUIVALENTS

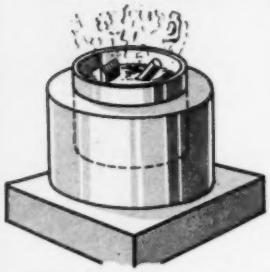
Rockwell scale C	Brinell scale	Sclero-scope	Moh
72	772	106	
70	760	102	8.5
69	755	98	
68	740	96	
67	725	94	
66	712	93	
65	699	92	
64	685	90	
63	672	89	8.0
62	657	86	
61	645	85	
60	631	84	
59	617	—	
58	603	81	
57	590	—	
56	577	78	7.5
55	562	75	
54	550	74	
53	536	73	
52	523	—	
51	510	71	
50	497	68	
49	486	—	
48	473	66	
47	462	64	7.0

HANDY FILE HARDNESS TEST

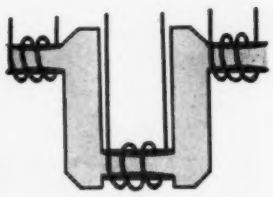
Brinell hardness number (approx)	
100	Metal removed easily by file
200	Slightly more pressure needed on file to remove metal
300	Metal shows resistance to file
400	Takes more pressure on file
500	File removes almost no metal
600	Metal cannot be filed

INSPECTING machined hard-facing deposit on large gate-valve disk for defects. Disk takes high pressure and temperature

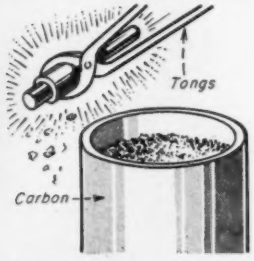
SOME WAYS OF CASEHARDENING STEEL



CYANIDE salt is melted to make bath where parts "bake"



INDUCTION hardening uses low voltages, high amperage



CARBON-containing powder is also used for casehardening

CARBURIZE by packing parts in charcoal, other materials

One Way to Fight Wear Is to Make Steel Hard and Tough

There are quite a few things that can be done to steel to make it harder or tougher. Changing the carbon content makes a lot of difference. For example, carbon content accounts for the difference between pure iron, steel and cast iron. Let's see why:

Carbon Content. Pure iron, known as *ferrite*, is soft, but tough, ductile and malleable. Of commercial metals, *wrought iron* comes closest to pure iron. It's essentially ferrite with fibrous slag inclusions. Adding carbon to pure iron makes a big difference. Relatively small quantities (less than about 1.7%) form what we know as *steel*. *Cast iron* has even more carbon.

So it's carbon that makes our modern steels. How does it get into iron? Mostly from the coke used as fuel in blast furnaces. From the time iron gets spongy it continues to absorb carbon. It usually takes all it can hold—3 to 5%. Later carbon is burned out in converting pig iron to steel. For exact control, small quantities are added in the finishing operations.

Heat Treating. In addition to adjusting carbon content, we can change the character of steel by *heat treating*. As steel is heated, molecular changes occur at temperature levels called critical points. Changes in structure also occur as the steel cools, but the critical points come at slightly different temperatures. If the cooling is slow (*annealing* or *normalizing*), the final structure is similar to the original one. This will usually change the grain size and the mechanical properties.

Rapid cooling, by quenching in water for example, arrests the structure changes at some intermediate point, giving a harder structure. This is *hardening*. In general, the higher the carbon content, the harder the steel can be made.

Some structures formed by heating and quenching are unstable. If we heat hardened steel to temperature below the critical points, structures begin to change. Quenching at the right point gives a steel that is less brittle. This carefully controlled reheating and quenching is called *tempering*.

Alloying. Hardness and other characteristics of steel can also be altered by adding small amounts of other elements to form *alloys*. By juggling carbon and alloy content and by using the many kinds of heat treatment, we can tailor steels to meet a wide variety of service needs.

Plating. Where surface protection is major need, electroplating or hot-dip coatings are used, particularly to protect against corrosion. Chrome-plating, as on the liners of internal-combustion engines, increases wear resistance. Coatings such as aluminum or chromium are also sprayed on surfaces to prevent deterioration.

Surface Hardening. For some services it's best to have a material that is tough and fairly soft, with an extremely hard outer surface. The general term for this is *casehardening*. There are two broad ways of casehardening: (1) heating the entire object and fixing things so it picks up additional carbon or other hardening agents at the surface, or (2) having a uniform carbon content but arranging to heat only the surface of the object. Big advantage of either scheme is that part may be machined first, then hardened.

Carburizing involves packing a heated low-carbon-steel part in carbonaceous material. Surface absorbs carbon and hardens when quenched. In the old days, carbon was absorbed from bone, leather or similar materials. Today the carbonaceous materials are mixtures of charcoal, barium, calcium and sodium carbonates. Carbon may be absorbed from a gas instead of solid material.

In usual setup, part to be hardened is packed in a box with carbon-giving material. Box is sealed and heated to 1700-1800 F. Resulting hard "case" may be from 1/32 to 3/32 in. deep.

Cyaniding, another long-familiar process, doesn't penetrate so far. Cyanide salt is melted to form a bath. Parts to be hardened are dumped in and allowed to "bake" depending on hardness depth desired. Or part may be heated and plunged into dry cyanide salt. While resulting case is only a few thousandths thick, process is quick. Caution: Cyanide fumes are deadly poison.

Nitriding uses ammonia as source of nitrogen, the hardening agent. Only 900 to 1100 F is needed so chance for warping is lessened. Treatment can be used on alloy steels or steels of high carbon content. Nitrided case is extremely hard and corrosion resistant.

Surface-heating methods are widely used today. Steel of right carbon content is heated by a flame or by induction so only the surface is affected. Quenching then gives a hard surface with a tough core.

To induction-harden a crankshaft journal, for example, inductor blocks are snapped around surface to be treated. Then a high-frequency (1000 cycles or so), low-voltage, high-amperage current is turned on for a few seconds. Sprayed water does the quenching. This method is well suited to production-line operations.

So we see there are many ways to make steel more wear resistant. But most of the schemes we've just talked about apply to new parts. What can we do about boosting the wear resistance of parts already in service, perhaps already worn? For the answer to this big maintenance question we turn to . . .

Another Way—Hard Facing—Applies Alloys to the Surface

As we generally use the term, *hard surfacing* (hard facing for short) involves applying an alloy coating to a metal part. The facing alloy is usually chosen for wear resistance, but other factors such as corrosion may enter the picture. Hard facing is widely used in production. But one of its great advantages lies in its suitability for maintenance work—protecting parts exposed to tough wear conditions and building up parts already worn.

Hard-facing alloys are most often applied by electric arc or gas torch, but there are several other methods particularly suited to some types of alloys and applications. Later pages of this manual give practical pointers on ways to apply hard facing. Right here, let's take a look at the many metals that can be faced and the many alloys available for the job.

CRUSHED CARBIDES come in bulk, in screen sizes shown. They are diamond substitutes and extremely hard. Use for unfinished surfaces needing high abrasion resistance

CARBIDES also come in tubular welding rods like this

INSERTS or blanks of tungsten carbide come in a variety of shapes. Braze or weld to the base metal

Which Metals? While most common engineering metals can be hard-faced, there are some exceptions and in many cases you have to know just how to do the job. Here's a rundown on familiar metals—what you can and can't do:

Low- and medium-carbon steels (less than 0.5% carbon) can be hard-faced by electric arc or oxyacetylene.

High-carbon steels (more than 0.5% carbon) can also be faced by arc or torch, but you may have to heat-treat some jobs before and after facing to remove hardness and brittleness, prevent cracking.

Low-alloy steels are in about same class as carbon steels. Depending on composition, you may need to heat-treat.

Manganese steels (11-14% manganese) are built up by the electric arc. Cool base metal to avoid overheating. After applying welding heat uniformly, peen deposit with machinist's hammer to relieve cooling stresses.

The high-chromium and chrome-nickel steels, worn in service, may be restored by electric arc and torch. Be sure to know the properties of each type you work on. Heat evenly and cool slowly to prevent warping or cracking, because most steels of this class have a high coefficient of expansion. Doing the job right and knowing the metal's composition helps avoid brittleness and loss of the facing's corrosion resistance.

Gray and alloy cast iron: When facing with arc or torch, watch thin edges. Cast iron's lower melting point makes thin edges likely to melt off.

Malleable iron can be hard-faced, but welding heat hardens iron directly under facing. You may have to remove hardness by reheating finished job to above 1500 F.

Monel metal hard-faces easily and gives no trouble with ordinary care.

Brasses and bronzes, along with some other nonferrous alloys, are very easily surfaced with similar copper-base metals. Heavy sections preheated to a red glow can be faced by electric arc.

Copper and copper alloys conduct heat rapidly and have low melting points. Method used with brass may work.

Aluminum and aluminum alloys cannot be hard-faced.

Comparative Ratings. With so many alloys on the market to help solve almost every problem, the American Welding Society prepared the table on p 112, Comparative Ratings of Surfacing Alloys. Ratings are given on a scale of 10 to 100: 100 means you can expect the best possible wear, while 10 usually gives the poorest for service shown.

How to Select Alloy: While all the many wear problems cannot be shown, table does include most general cases, with nearest general solution. Most

severe services take in a number of conditions, so choosing right alloy depends on over-all or combined use, rather than special need for one condition.

For some problems, this table may not give the best solution. In such cases, look for things of little importance that may be troublemakers. For instance, effect of chemical corrosion is not shown in table though in some cases it may be chief cause of failure.

Except under such unpredicted conditions, table does help choose an alloy, or group of alloys, that comes nearest to doing best job—under all setups.

Some services need high hardness without being porous, yet must attain a high polish. For such uses, you can't always get the most wear-resistant alloys, which are the tungsten carbides. Reason is that deposits with these metals wear to a rough surface. It isn't always easy to machine or grind a perfect surface on carbide deposits because of very hard particles.

Where corrosion is a problem, use a rust-resisting or corrosion-resisting alloy. Often, corrosion resistance is main factor, or it may be combined with other problems, such as wiredrawing or sliding metal-to-metal contact. Table suggests several alloys for such cases. Look under Type II in table, or to the grades of brass, bronze or nickel alloys.

Resistance to hot-deformation is another need. For this, alloys must have high hot-hardness. Several types of alloys, such as Types I-C and II, will do. Also, some services need a high degree of toughness at high temperatures. Some alloys in high-nickel group, Types V-B and V-C, are best here.

Metal-to-metal sliding and seating wear is different from soil-to-metal kind of wear of earth-handling equipment. While hardness is important to lick galling and deformation, best resistance to such service is usually a combination of similar metals. For this reason, bronzes are very popular here, as for sliding surfaces and on valve seats. These alloys come in various degrees of hardness because hardness is also often needed.

Corrosion may also be important, as for corrosive liquids or even for water service. But this quality can be given by choosing the right alloy. Some of the high-copper or nickel alloys and cobalt-base, nonferrous alloys have excellent corrosion resistance, along with good sliding wear resistance.

Where does cost of alloy come in? Well, often ideal alloy is also the highest-priced. So weigh benefits gained by using costly alloy, service you would get from slightly inferior alloy, cost of replacing worn parts altogether. It's the over-all picture that counts here.

Comparative Ratings of Surfacing Alloys

	Hardness	General atmospheric corrosion resistance	Resistance to earth abrasion	Resistance to hot deformation	Service under heavy abrasion	Service in sliding and rolling wear*
I. Ferrous						
A. Hardenable Alloys						
1. Carbon Steels						
a. Low	10	10	10	10	10	20
b. Medium	10-40	10	10	10	10	50
c. High	20-60	10	20	10	10	50
2. Low-Alloy Steels						
a. Low carbon	10	10	10	10	10	30
b. Medium carbon	20-40	10	10	10	20	50
c. High carbon	20-60	10	20	20	20	50
d. Cast-iron types	20-60	10	40	20	20	40
3. Medium-Alloy Steels						
a. Medium carbon	20-40	20	20	30	50	60
b. High carbon	30-50	20	40	50	80	60
c. Cast-iron types	30-70	20	50	60	50	40
4. Medium-High Alloy						
a. Low carbon	20-40	20-50	20	40	30	40
b. Medium carbon	30-60	20-30	40	50	70	60
c. High carbon	40-80	20-30	60	50	80	40
d. Cast-iron types	40-80	20-30	70	50	50	40
5. High-speed Steel	80	20	40	70	40	40
B. Austenitic Steels						
1. Chromium and Cr-Ni						
a. Low carbon	30	90-100	20	20	30	30
b. High carbon, low nickel	40	90-100	20	40	50	30
c. High carbon, high nickel	40	90-100	30	40	50	30
2. High manganese	40	50	20	20	80	50
C. Austenitic—not usually heat-treated						
1. High-chromium Iron	60	60-80	70	80	80	80
2. High-Alloy Iron						
a. 1.7% carbon	70	60-80	60	60	70	70
b. 2.5% carbon	70	60-80	70	60	60	80-90
c. Very high alloy	80	60-80	80	60	50	90-100
II. Cobalt Base Alloy						
A. Low Alloy	40	90-100	50	100	80	90-100
B. High Alloy	70	90-100	70	100	60	100
III. Carbides						
A. Inserts	100	60-80	100	100	50	100
B. Composite	75-100	30-60	100	.....	70	.....
C. Powder	.....	.....	100	.....	70	.....
IV. Copper Base						
A. Copper-Zinc	20	60-80	20	10	10	80-100
B. Copper-Silicon	25	60-80	20	10	10	50-70
C. Copper-Aluminum	25-40	60-80	30	10	10	70-90
V. Nickel Base						
A. Nickel-Copper (Monel)	20	80-100	20	10	20	20
B. Nickel-Chromium (Nichrome)	30	80-100	40	70	40	60
C. Nickel-Chromium-Tungsten-Molybdenum (Hastelloy)	50	90-100	50	90	60	80

*In combination with suitable companion alloy

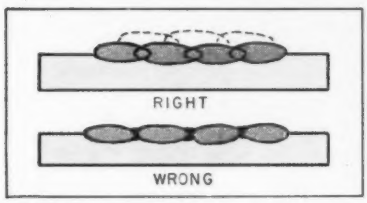
Melting Points of Metals

Metal or alloy	Melting point F
Carbon	6332
Tungsten	6152
Tantalum	5160
Molybdenum	4532
Titanium	3270
Iron, wrought	2900
Iron, pure	2786
Chromium	2740
Cobalt	2700
Steel, less than 0.15% carbon	2700
Nickel	2646
Steel, stainless (18-8, low carbon)	2640
Steel, cast	2600
Steel, nickel 3½%	2600
Steel, medium, (0.15 to 0.40% carbon)	2600
Silicon	2588
Stainless steel, (18% chromium, 8% nickel)	2550
Steel, hard (0.40% to 0.70% carbon)	2500
Nichrome	2460
Steel, manganese	2450
Steel, nickel, manganese	2450
Stellite (average)	2336
Iron, cast	2300
Iron, malleable	2300

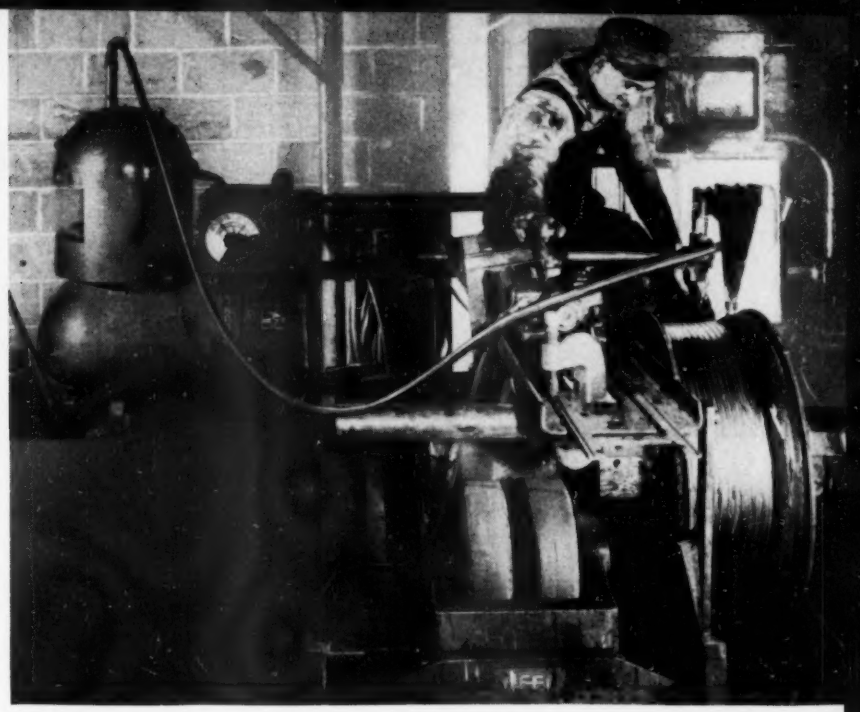
Symbols of Elements

Aluminum	Al
Argon	A
Beryllium	Be
Boron	B
Carbon	C
Chromium	Cr
Cobalt	Co
Columbium	Cb
Copper	Cu
Hydrogen	H
Iron	Fe
Manganese	Mn
Molybdenum	Mo
Nickel	Ni
Oxygen	O
Silicon	Si
Sulfur	S
Tantalum	Ta
Titanium	Ti
Tungsten	W
Vanadium	V
Zirconium	Zr

NEEDLE VALVE for tough use finished with alloy of cobalt-chromium-tungsten



OVERLAP hard-facing beads, then lay second-layer beads between first beads



SUBMERGED ARC is semi-automatic. Bare electrode wire is power-fed through blanket of alloy flux. Alloy pickup from flux gives up to 62 Rockwell C hardness

DOING THE JOB:

1—Electric-Arc Welding Method

Two major hard-facing tools are the electric arc and the oxyacetylene torch. The electric arc deposits alloys fast so heat doesn't penetrate deep. But steel with more than 0.3% carbon may crack unless preheated. Because arc heat is intense, base metal melts near surface. This dilutes the first layer of hard-facing alloy with base metal—more than when a torch is used. It may take two or more layers to get undiluted hard facing.

Electric arc forms when two conductors of an electric circuit touch, then separate, and there's enough voltage to maintain current flow across the gap. Arc is struck between a carbon or metal electrode connected to one terminal of a generator, and the metal to be welded, which is connected to the other terminal. Arc size is varied by changing distance across gap, altering current output, or putting resistance in the circuit. Distribution of heat in the arc depends on current density in the electrode.

For *straight polarity*, connect electrode to generator's negative terminal; for *reverse polarity*, tie to positive.

Hard-facing electrodes are both bare and coated. The flux coating reduces spatter loss, assures good penetration, prevents oxidation of deposited metal and helps stabilize the arc. Flux makes metal "wet" easily so weld metal flows and diffuses through melted flux. It also helps carry flame-produced oxide to the surface so it doesn't remain to contaminate the hard facing.

Current Settings. If you don't have electrode maker's data, use the table below as a handy guide:

Rod-size, in.	*Current, amp*
1/8	80 to 110
3/16	150 to 200
1/4	200 to 350

Low or medium current with a short arc of about 3/16 in. prevents loss of alloying metals. It also reduces dilution of alloy by giving minimum penetration. Increasing current increases penetration, softens deposit, and increases dilution with base metal.

Electrode size depends on nature of work and current that it is to carry. Because the electrode acts as an electrical conductor, be sure to use right current for each size electrode.

Good rule is to use largest convenient rod for the job. Large electrodes permit faster work because more metal is deposited. They are cheaper and faster and their arc stability is often greater. But if material is crack-sensitive, use a small-dia electrode. That reduces heat input and also danger of distortion.

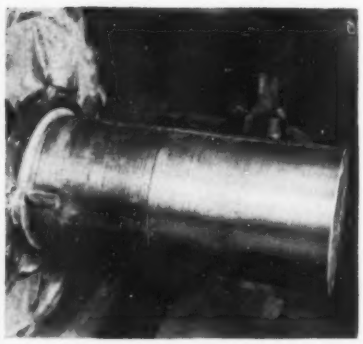
Use only dry electrodes. Best way is to make sure they are kept clean and are stored properly in a dry place. When using, be sure to avoid trouble by following the manufacturer's directions. Better hard-facing jobs will more than pay you for your troubles.

Submerged arc (photo) increases depositing speed 3 to 4 times because high current density with small wire gives high burnoff rate. For example, 600 amp on 5/64- or 3/32-in. wire is equal to 100 amp on 5/16-in. electrode. Alloy pickup is from granular flux, containing alloy needed, as flux pours from funnel and hides arc. Inexpensive wire can thus make hard-facing deposits of 36 to 62 Rockwell C hardness.

Twin carbon arc has two carbon electrodes in holder, gives softer arc and will even hard-face thin materials without burning through. Reason is that current flows from tip of one copper-coated and cored carbon to other, not through metal being surfaced.

More About the Electric-Arc Method: How to

Getting Ready



WEAR on this shaft comes from highly abrasive coal dust working into bearing

WHICH ELECTRODE?

Build up shaft with Type I, A, 2 (table, p 112) iron-base rods having less than 20% alloying elements. For a surface resistant to abrasion, finish with Type I, A, 4 iron-base rods having more than 20% alloying elements

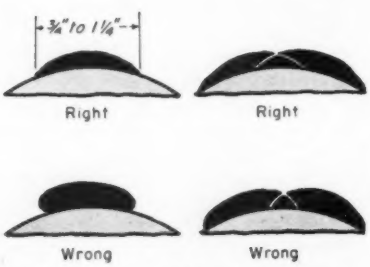
Electrode dia, in.	*Current, amp straight*	*Voltage, arc volts*
1/16	20 to 40	17 to 20
5/64	25 to 50	17 to 20
3/32	30 to 80	17 to 21
1/8	70 to 120	18 to 22
5/32	120 to 170	18 to 22
3/16	140 to 240	20 to 24
7/32	170 to 300	21 to 25
1/4	200 to 350	22 to 26
5/16	250 to 450	23 to 27

Electrode dia, in.	*Current, amp reverse*	*Voltage, arc volts*
1/16	20 to 40	17 to 20
5/64	20 to 60	17 to 21
3/32	30 to 80	17 to 21
1/8	80 to 130	18 to 22
5/32	120 to 180	18 to 22
3/16	140 to 250	20 to 24
7/32	170 to 300	20 to 24
1/4	200 to 400	20 to 24
5/16	250 to 500	22 to 26

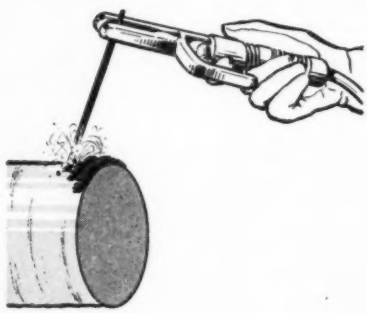
ELECTRODE size, amperage and polarity

Applying the Facing

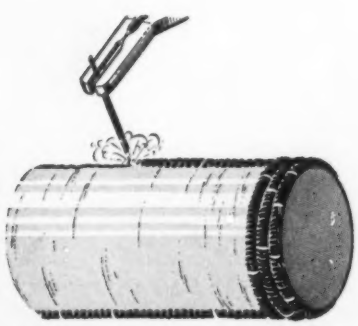
4 Ventilate well if the welding must be done inside some confined space



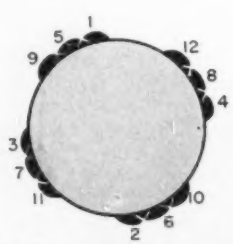
5 Bead must spread as shown. Be sure it overlaps to avoid porosity, slag



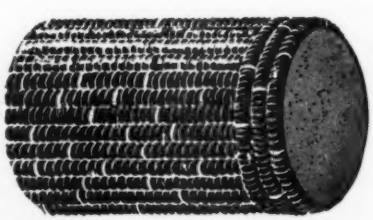
6 Run two or three beads around circumference few inches at shaft's end



10 Run next bead on opposite side of shaft to distribute the heat evenly



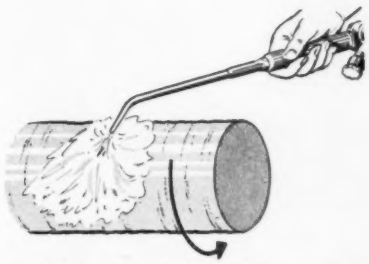
11 Use bead sequence shown to prevent shaft from distorting permanently



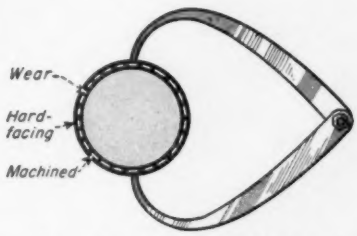
12 Stagger the bead ends all around the shaft, as here, to strengthen pads

Put It to Work Hard-Facing a Worn Stoker Shaft

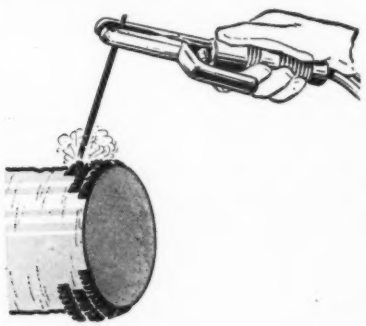
1 Clean shaft with safe solvent, such as trisodium phosphate; rinse and dry



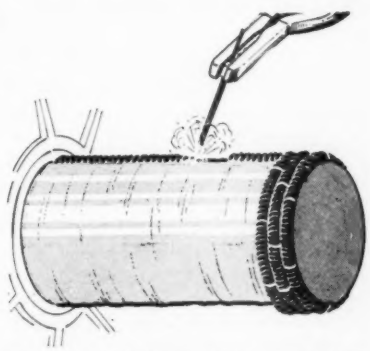
2 With a gas torch, preheat part to be coated—just enough to remove chill



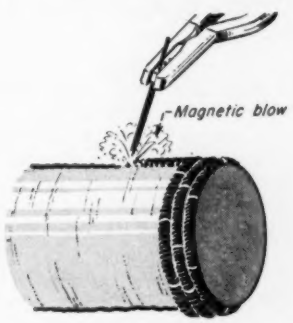
3 Set calipers for finished size plus 20% for finish machining, shrinkage



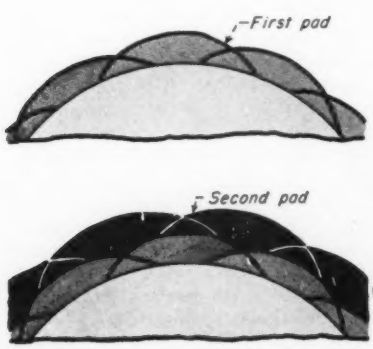
7 Turn shaft around and run some beads on other side to spread heat evenly



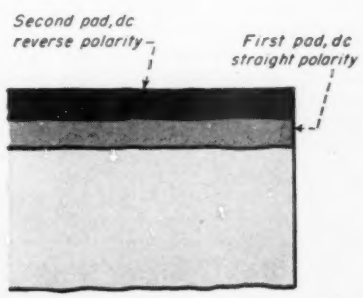
8 Run bead along shaft. Start from outer edge and work in from the end



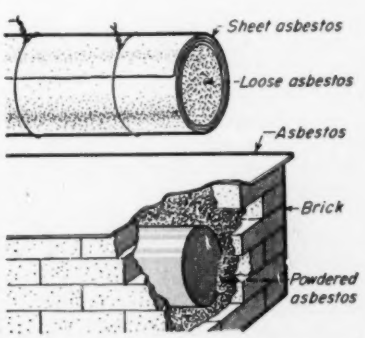
9 Stop if you have magnetic blow (this happens with ac); start at other end



13 Laying second pad, with Type I, A, 4 alloy: put beads between first ones

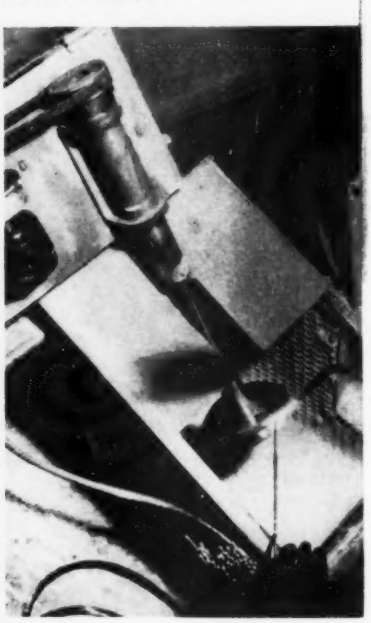


14 First pad takes dc straight polarity, second pad, dc reverse polarity



15 Cool slowly by covering shaft with sheet or powdered asbestos, as shown

WORN CAMSHAFT LOBES are built up with torch. Water keeps shaft from warping by carrying away heat. This repaired job will last much longer than a new shaft



DIESEL VALVE turns slowly while hard-facing rod is deposited around its seat

2—Oxyacetylene-Torch Method: It's Handy for Parts

Big advantage of surfacing by oxyacetylene torch is that surfacing alloy can be applied by flowing alloy onto the base metal with a technique known as sweating or tinning.

These terms describe formation of a lower-melting-point element that enables alloy to flow onto base metal while hardly melting it.

Term "sweating" refers to action that takes place when applying high-melting-point ferrous, nickel and cobalt-base alloys because of using an excess acetylene flame. This flame carburizes the surface of base metal, which in turn lowers melting point of the film. Alloy flows easily over this thin liquid film.

Term "tinning" describes action when surfacing with bronze or copper alloys. Only here it's more like a cleaning action caused by flux or flame that prepares base metal ahead of the welding action. That allows capillary flow of low-melting-point alloys onto the higher-melting-point base metal.

Flame Types. To burn acetylene gas completely takes 2½ times its own volume of oxygen. But about equal volumes of the two gases are fed through the torch. Other volume and half of oxygen is gotten from the air. The combustion of acetylene in oxygen produces carbon monoxide and hydrogen. Oxygen for burning the CO and H_2 to carbon dioxide and water vapor comes from the surrounding air.

Hard-facing flames usually have an excess of acetylene. Sketch shows a neutral flame—equal volumes of acetylene and oxygen going into the torch. Increasing the acetylene builds up a white flare caused by unburned white-hot carbon particles. These free-carbon particles tend to carburize the surface of the base metal and also to reduce any oxides present to the metal form. So excess-acetylene flames are also called carburizing flames and reducing flames.

The usual hard-surfacing flame has a white flare about three times as long as the inner cone. This flame gives good sweating action because the free-carbon particles are absorbed into the base-metal surface, lowering its melting point. Melting of an extremely thin surface layer provides a liquid medium on which molten facing alloy flows. Carburized base metal, to a depth of about 0.001 in., is absorbed by alloying with the molten hard-facing layer. So gas-welded deposits can be made with penetration less than 0.010 in. into the base metal.

How Much Acetylene? Excess-acetylene flame also prevents loss of carbon content from welding rod and may even increase carbon content of weld deposit from 0.2 to 0.4%. Because some alloys absorb carbon from flame, hardness of deposit depends on excess acetylene used, and on cooling rate of finished work. But long excess-acetylene "feathers" are unsatisfactory because they are not as hot, put too much carbon into deposit and make poor welds.

Always keep inner cone from touching molten metal already deposited. Inner cone contacting puddle puts in too much carbon. That hardens deposit, which might cause cracks. Keep inner-cone tip 1/16 to ⅛ in. away.

A slight reducing flame is used with rods having fairly high iron content, where dilution of facing alloy with base metal is not serious. When working on cast iron, watch corners and sharp edges, because cast iron has a lower melting point than many hard-facing rods.

When hard-surfacing with the gas torch, use only a slight excess of acetylene. Use flame to keep air from contact with molten metal. This prevents oxidation. Never remove flame completely until metal starts to solidify.

Which Way? Deposit hard-facing alloys with either forehand or backhand technique, sketch. Forehand is usually

EXCESS hard-facing metal is wiped away from this sprocket wheel while plastic

NO GRINDING needed; contour is formed by die while the alloy is still plastic

To Be Finished to Close Tolerances

recommended because penetration is controlled easier, rod is deposited faster with less scale in molten pool.

Backhand technique shown is also common with the sweating method. Direct excess-acetylene flame at a 30- to 60-deg angle to the surface. As you deposit alloy, move flame back to remelt rough spots, get a smoother finish.

Typical Job. Torch method is handy for doing parts that will be finished to close tolerances by machining or grinding. Cam shaft of internal-combustion engine, photo on facing page, forms a typical job. To repair worn lobes, partly submerge shaft in water so heat is carried away and shaft doesn't warp.

In photo, shaft is held in place with a plastic compound at end of pan. Get this at a supply house or substitute loose asbestos mixed with lube oil. Heat can also be removed by packing wet asbestos around shaft, building it up to area being surfaced.

Set torch to carburizing flame and hold against cam lobe until metal sweats. Extent of sweating area depends on size of welding tip, but it should extend a distance of ¼ in. around excess-acetylene flare.

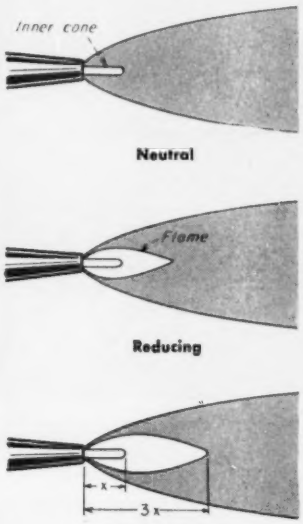
Withdraw flame enough so end of rod is between flame's inner cone and the hot base metal. Apply the rod to sweated area, with tip of inner cone just touching rod. As rod melts a pool forms, flowing over sweating area. Remember: Base metal is too cold if first few drops don't flow evenly.

Remove rod from flame and flow molten pool where wanted by playing flame on it. Return rod to flame and melt off more metal into pool. Keep flame on front edge of molten pool so flame keeps it molten and also sweats base metal in front of pool. Move rod in and out of flame as it moves steadily forward. Float off scale specks, don't cover them up.

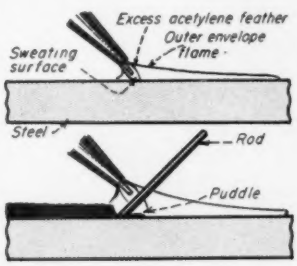
Keep supplying the pool from the rod as the pool flows forward. Use rod so it deposits molten metal uniformly at a steady rate over area to be covered. On round work, this is easier if work is turning. Play the flame over the deposited alloy from time to time to remelt and smooth out any high or low spots, left behind.

Plastic Working. The sprocket wheel in the photo above is built up with an alloy that can be worked in the plastic state. Rod is used to wipe away excess alloy. Then, while alloy is still plastic, it's die formed. This establishes the contour without need for grinding. The alloy used is 75% nickel, 25% chromium and boron and wears very well.

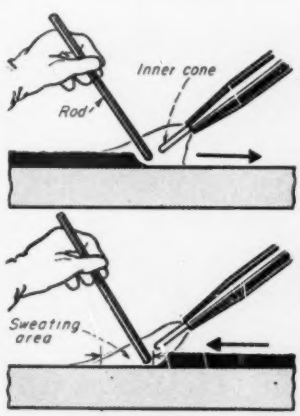
Right Flame and Welding Methods for Job



CARBURIZING. The flame welds but hardly dilutes facing alloy



SWEATING (top): Relationship of the tip, rod and base metal



BACKHAND (top) or forehand depends on welder's preference

3—Spraying Methods: They Use Alloys in Powder or Wire Form

FIRST, adjust powder and flame with knobs on top of the gun. Then, open gun's trigger as shown. Powder is now spraying.

SECOND, build up corners of undercut by hand, while shaft revolves in lathe

THIRD, run gun back and forth by feed of lathe. Shaft builds up to size here

FOURTH, second stage is fusing alloy to shaft with large gas torch at right temp

MANY ALLOYS may be sprayed on by one of several methods. Spraying gives a thin, uniform coating—from a few thousandths thick up to 0.60 in. Contours and shapes are easily coated. Spraying also handles alloys not easily applied in rod form.

In one method, alloys are sprayed from a suitable gun, then fused with a torch. In another, powdered alloy and plastic binder form a wire that's fed through a typical metalizing gun. Resulting deposit is then fused. Still a third way uses a special torch to apply a coating and fuse it in one step. Let's take a look at each scheme:

Spraying Alloys Available in Powder Form

Powder spraying is done with a gun roughly like that for metalizing, but with a powder hopper and a carburetor for mixing powder with air. This applies alloy but does not fuse it. A separate torch is used to fuse sprayed alloy to base metal. It can also be done in a furnace or by induction heating.

Typical Job. Conveyor shaft, in photo, of cold-rolled steel, wears badly in center. First, undercut it so there is at least 0.030 in. for hard facing all around. Never make sharp corners in groove, or oxide film will develop porosity when fusing and the coating will peel back.

Blast with angular-steel or aluminum-oxide grit, not round shot. Caution: Don't touch base metal. If it must stay in lathe overnight, cover it.

In lathe, blow shaft with compressed air while it revolves, then wire-brush. Adjust to neutral flame of 13-psi oxygen and 11-psi acetylene. Have 75-psi air pressure to propel powder.

Spraying. Turn on powder, then open gun's trigger and build up corners of undercut, holding gun in hand. Next, set gun in holder attached to toolpost and adjust so spray is against shaft's center. Start thread-cutting feed and reverse at end of each stroke. This sprays even layers of alloy. Spray on enough alloy to allow for shrinkage. This depends on coating thickness. Check with set calipers.

Fusing. With shaft built up to right diameter, use large torch with neutral flame. Play back and forth over revolving shaft, heating evenly. Then hold flame at one end of shaft, photo, until shaft has a transparent appearance. Move flame slowly along shaft as alloy shines under flame. Now alloy is fused to shaft. With asbestos gloves, remove part from lathe and drop into a box of powdered insulation for slow cooling overnight. This step is important or deposit will crack.

Unless cooled gradually, hot alloy shrinks faster than inside of shaft, and cracks. If alloy is inside a sleeve, fast cooling pulls alloy away from wall.

Spraying Alloys in Wire Form

Besides the many wires made for various metalizing jobs, hard-surfacing wire is made of powdered alloys extruded with plastic binder. Plastic evaporates in metalizing-gun flame, so only the alloy deposits on base metal. Alloys may be same as for powder spraying—only difference is that wire is deposited with usual metalizing guns.

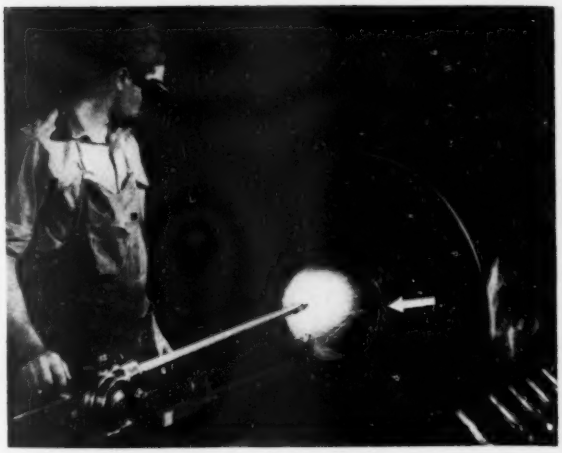
After spraying, deposit is similar to metalizing job, which means it's not fused. There are various ways of fusing: For small to medium work, use an acetylene torch. For larger work, use two or more torches, or put in a furnace.

Liner Job. Photo shows hard surfacing inside of a gas-engine cylinder liner. This isn't a common application and is probably one of the toughest to do right. But cylinder will have from three to four times more life than new.

First bake casting at from 450 to 500 F to burn oil out of cast-iron "pores." This is important on old oil-soaked castings. Baking takes about an hour, depending on heating method. On liner, Tempil-stick mark shows when right baking temperature is reached. This is a temperature-indicating stick that melts at given temperature.

Bore out to get rid of ring steps, fluted wear and scoring. Finish bore with a No. 18 or 20 thread final cut for anchoring alloys. Then grit blast. Preheat from 200 to 300 F. Keep gas torches on outside as shown to maintain this temperature while spraying.

Spraying. Metalizing tool shown is fed back and forth by lathe for smooth, even deposit. Spray cylinder up to original diameter, plus about 0.030 in. for finishing. Because alloy used here is over 50 Rockwell C, and hard to machine, cylinder will have to be finished by grinding.



WIRE BEING SPRAYED inside gas-engine liner is a powdered hard-facing alloy bound by a plastic that vaporizes in flame

Fusing. After spraying, bring up to shiny red heat for fusing. For this job, a furnace is best, as it will give even heat at all parts of the liner. Then allow to cool gradually over a few days until room temperature is reached. If liner cools too fast, or unevenly, alloy coating pulls away from the liner. For most jobs, but particularly for one like this cylinder liner, slow, uniform cooling can't be overemphasized.

Spraying Powdered Alloys and Fusing Them in One Operation

This method feeds powdered hard-facing alloy onto the base metal through an oxyacetylene flame, as when spraying powder and wire. But here the process differs.

Powder, with flux if needed, is projected through the flame by an auxiliary gas, such as carbon dioxide, nitrogen or hydrogen, by means of a spray gun that is specially designed for the purpose.

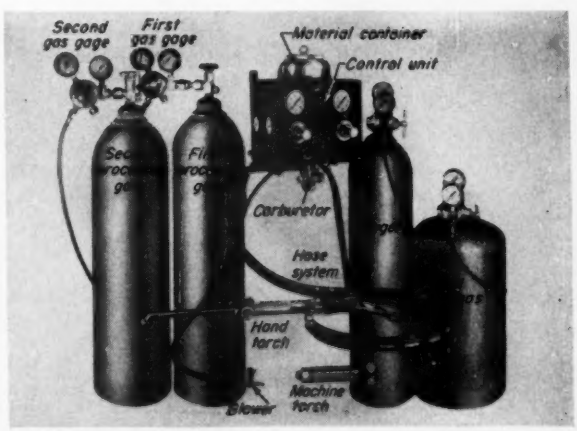
Continuous Fusing. Temperature of oxyacetylene flame is adjusted so deposit is continuously fused or braze-welded to the base metal. This makes the process something like oxyacetylene hard surfacing, as the base metal is prepared and must be preheated and treated in the same way.

One advantage is that coatings as thin as 0.010 in. may be deposited. Up to 0.150 in. of coating has been applied. There is a full bond with base metal, as the deposit is completely melted without a second fusing operation.

Control. Accurate control of base-metal temperature is obtained by increasing or decreasing amount of flame, then proportioning the projecting gas (and alloy), and the processing gas. Both base-metal and alloy temperatures are controllable, all the way from melting temperatures down. This gives a high-quality metal-bonded hard surface.

Equipment. Photo shows torch, control box with air- and gas-pressure regulating valves, and hopper for powdered metals. Torch resembles usual welding torch but has three control knobs on the handle. These are part of a total of 16 controls on the apparatus for accurate regulation of all operating conditions. Torch also applies plastics or synthetics.

Alloys containing beryllium, bismuth, carbon, cobalt, molybdenum, tungsten, etc, may be deposited with this equipment (not yet commercially available to the industry).



POWDERED ALLOY FUSES to base metal as deposited under regulation of controls that help operator make needed adjustments

COKE CHUTE, hard faced with chromium-boride crystals applied in paste form, is expected to last about eight times longer

4—Spread Alloy in Paste Form as if Icing a Cake

Some hard-facing materials come in paste form. One of these is chromium-boride, which reads 68 to 72 on Rockwell C scale. It has good resistance to extreme abrasive wear found in materials-handling chutes, fan blades, pump impellers, scraper blades, crusher rings, screw conveyors, etc.

In addition to resisting abrasion, chromium boride is good against corrosion and impact, has hot-hardness qualities. It's easy to apply, by carbon arc or oxyacetylene torch.

Applying Paste. Clean base metal thoroughly. If there's scale or rust, remove by grinding, shot-blasting or sanding with abrasive cloth. Amount of preparation needed depends on previous service of material to be coated. Watch out for problems like oil-soaked castings. If not baked out, oil can cause hard-surfacing job to fail.

Ordinarily, preheat the work to about 100 F. Play oxyacetylene flame or blow torch back and forth across piece so it heats up slowly and evenly.

Paste comes in cans, mixed with water. If it's too thick, add water and stir to the right consistency. Then spread it on metal with a putty knife, a stiff brush or a piece of wood. Coating thickness runs about 1/16 in. Putting on the paste is much like icing a cake. Next, let paste dry. The preheat evaporates the water quickly.

Sweating. If metal to be coated is 14-gage or less, use oxyacetylene or carbon arc torch. Spread paste about 1/64 in. Heat base metal up to sweating temperature. Fusing of base metal and paste will show as a dark line ahead of the torch flame. Move torch across work, keeping the dark line ahead of the flame.

For metal of over 14-gage, use standard carbon electrode of 3/16, ¼ or ⅜ in. dia, depending on thickness of base metal. Have straight polarity with just enough current to maintain arc. Hold carbon about 80 deg to the vertical.

Using Carbon Arc. Work with a quarter-moon weaving motion, not over 2½ times diameter of carbon. Point carbon in pencil sharpener or by holding against grinding wheel. If handled right, carbon melts so point stays as it should. Have about 3 in. of carbon sticking out of holder.

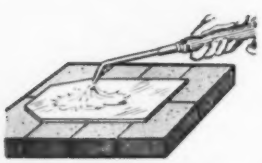
Keep black spot of carbon floating on the surface just in front of the point. After sweating-on first weave, pass across work and return with about half the width of the second weave overlapping the first. If you get porosity on the edge of the weave, pay no attention. It will disappear when you overlap the next weave.

Use paste made of chromium-boride crystals only on rough work that is not to be finished.

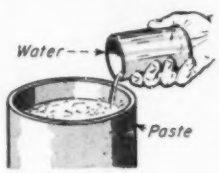
Sweating-On Powder. Chromium carbide comes as a powder, mixed with flux. Sprinkle it on the base metal and fuse with a carbon arc or carbon arc torch for a smooth, dense, abrasion-resisting surface, which can be as thin as 0.025 in.

Hardness depends on mixing with base metal, runs about 54-61 Rockwell C for one layer and 57-63 for second. Deposit develops full hardness in resisting scaling at high temperatures. Corrosion resistance is like that of stainless steel. Don't use this type of alloy where impact is great.

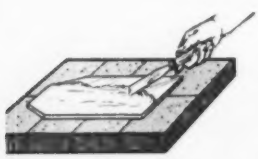
FOLLOW THESE EASY STEPS



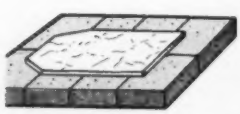
1 Preheat base metal with torch to only about 100 F



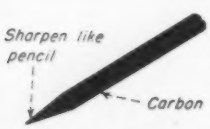
2 If paste is too thick, mix with water to thin out



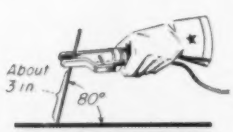
3 Spread on about 1/16 in. thick, as if icing cake



4 Let paste dry—the preheat does the job quickly

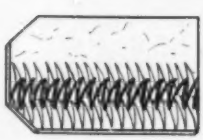


5 Use about ¼-in.-dia carbon, pointed like pencil



6 Use straight dc polarity and hold carbon as shown

7 Weave quarter moons, and use lowest amperage



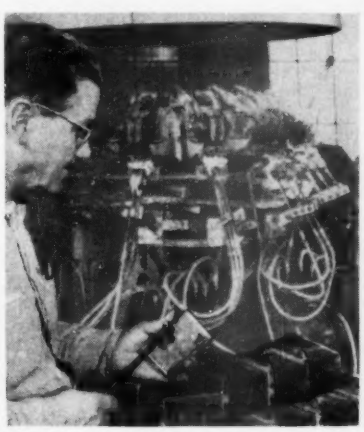
8 Reverse, overlap the previous stringer, as shown

1 Grit-blast the tungsten-carbide inserts to remove the surface oxides and other films. Machine surface of the base metal, then do a thorough degreasing job

2 Flux surface of the base metal with brush. Before fluxing, clean in carbon tetrachloride. Degreasing, cleaning and grit-blasting must be done properly

3 Position silver-solder strips after fluxing. Place one strip on base metal, a copper screen on the solder strip and second solder strip on copper: flux

4 Put the tungsten-carbide inserts in place, on top of "sandwich" of silver-solder strips and copper screen. Six inserts are butted together on this job



5 Heating to 1350-1400 F by the propane-air burners against underside of base metal bonds the inserts. Test bond by tone of a hammer blow as shown

6 Attaching hard-faced peg to moving rotor of coal pulverizer. Coal gets pulverized by impact and attrition between moving and stationary pegs shown

5—Brazing Tungsten-Carbide Plates

Diamond-substitute alloys of Type III, A (see p 112) come as inserts of various shapes. Some contain 90 to 95% tungsten carbide. Remaining 5 to 10% is nickel, cobalt, iron or other elements to give the desired properties.

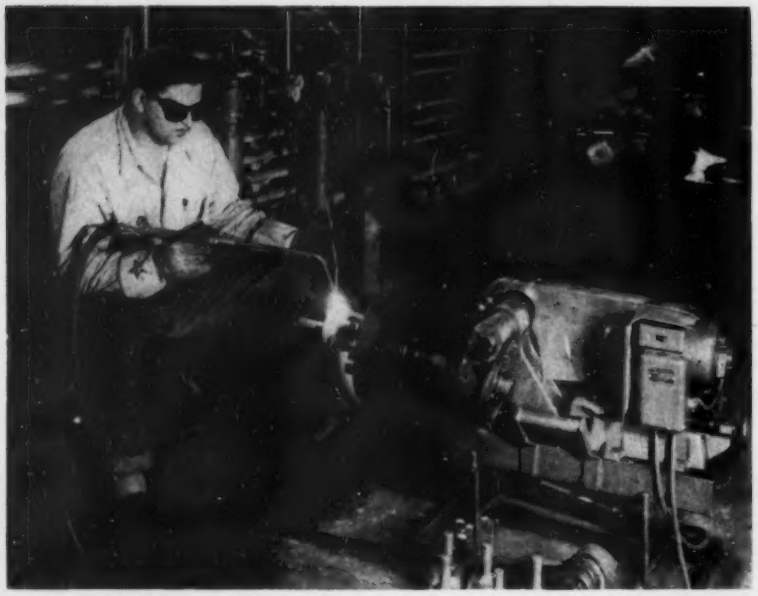
Braze these carbide plates to wearing surfaces because brazing heat (torch flame) will not melt the carbide materials. They do "wet" easily, so can be bonded to metal surfaces.

Because stationary and moving grinding pegs of the coal pulverizer shown take heavy punishment from impact and abrasive wear, they are hard faced with inserts of tungsten carbide. Here are steps in typical application:

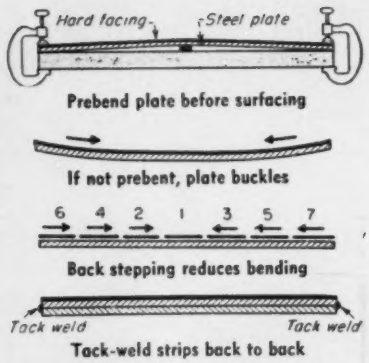
Operations. (1) Machine surface of base metal to be hard-faced. (2) Degrease with trichlorethylene, clean with carbon tetrachloride. (3) Grit-blast tungsten-carbide inserts with silicon-carbide grit to remove surface oxides and other films.

(4) Flux machined surface of base metal with brush. (5) Cut strip silver (silver solder) to size and dip in flux. Then put in position on base metal. (6) Dip a copper screen or copper sheet in flux and place on strip silver. Because insert's coefficient of expansion is not the same as the base metal's, always put copper between. This also takes impact shock, as inserts are hard, with no "give." (7) Flux second strip of silver alloy and place on copper. (8) Put inserts in position on top layer of strip silver. (9) Braze by directing flame under base metal until both strips of silver melt. (10) Test bond by tapping inserts with a hammer. Tone indicates the quality of the bond.

Tungsten carbide can also be used to tip your maintenance tools. Technique is same as explained on this page.



TURNING MACHINE holds round parts in chuck which revolves at a steady rate so operator has his hands free, can do smoother job. Foot pedal controls the speed



Avoid Buckling. If not preheated or prebent, thin pieces will buckle, see sketch. One way to minimize buckling is to "backstep," sketch. Deposit short strip in center, first working on one side, then on the other. Always work toward the center.

Another way to prevent buckling is to tackweld two thin pieces together. With backstepping, a good welder can cut down warpage to a minimum. Small pieces can be partly submerged in water to carry heat away from hard-facing areas at the surface.

Here Are Handy Pointers to Make Your Hard Facing Better

Preheating metal before hard facing distributes and equalizes stresses set up by pull exerted from cooling deposit. Preheat temperature depends on type of base metal and facing alloy.

Heat by playing flame over metal. Or place part in an oven. Some jobs can be induction heated. When hard-facing small pieces with a torch, flame ahead of molten metal often does enough preheating.

How Much Preheat? The more preheating the less warpage. If a long, flat piece of sheet iron is heated to same temperature as alloy deposited, both metals naturally contract together on cooling. Only chance of warping occurs if rates of expansion are different. But usually it's only practical to preheat a few hundred degrees.

Cooling hard-facing deposit does not have a firm hold on the base metal, however, because part of pull is taken up by plastic movement in molten deposit. And the hotter you keep the job while hard-facing, the easier it is for plastic movement. Caution: If base metal is kept hot enough to be near plastic state, facing deposit will tend to compress the base metal.

No Preheating. When hard-facing thin metal, prebend as in sketch above. Bend plate over thin center piece and clamp ends to heavy piece of metal. Unclamp when you finish hard facing so cooling alloy pulls plate straight. Experience shows how much to prebend.

Relieve stresses set up during hard facing by tempering or annealing deposit from 1000 to 1200 F, depending on the metal. For complete stress relieving, entire piece must be heated and cooled slowly.

Cooling. One method of slow cooling is to drop small parts into a container of powdered insulation, allow to stand for about two days. Keep hard-faced parts away from moving air and cold metal while cooling. Place on fire brick and cover with insulation, if pieces are large. Or drop in lime, dry sand, mica. Even sawdust does a good job—it burns slowly.

Theory of slow, even cooling is to keep one part of piece from cooling and contracting fast, pulling on slower cooling parts. That may cause cracks or serious distortion.

Special Equipment. Turning device shown in photo above speeds work, gives smoother deposit. A contact pyrometer is handy to register exact temperature for preheating or annealing. Portable, it can be carried to any job. Large dial shows temperature when instrument touches metal to be tested.

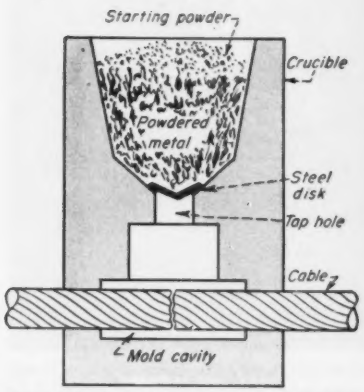
ACKNOWLEDGMENTS

For liberal use of technical data POWER is indebted to the following manufacturers: Adams Alloy Co; Air Reduction Sales Co; Alloy Rods Co; AllState Welding Alloys Co, Inc; American Agile Corp; American Manganese Steel Div, American Brake Shoe Co; Ampco Metals, Inc; Arcos Corp; Bergstrom Overlay Metals, Inc; The Bristol Co; Canton Alloys, Inc; Carboloy Dept, General Electric Co; The Champion Rivet Co; Coast Metals, Inc; Crane Co; Crucible Steel Co of America; Electric Arc, Inc; Eutectic Welding Alloys Corp; Harnischfeger Corp; Haynes-Stellite Co; Hobart Bros Co; International Nickel Co, Inc; The Lincoln Electric Co; Linde Air Products Co; The MacDonald Co; Metallising Co of America; Metallizing Engrg Co, Inc; The McKay Co; Mir-O-Col Alloy Co, Inc; Permalatem Welding Alloys, Inc; Powder Weld Process Co; Rankin Mfg Co; Reid-Avery Co, Inc; The Sight Feed Generator Co; A O Smith Corp; Steel City Testing Machines, Inc; Stoody Co; Stulz-Stickles Co; Tempil Corp; Victor Equipment Co; Wall Colmonoy Corp; Welding Equipment & Supply Co; Wilson Mechanical Instrument Div, American Chain & Cable Co, Inc, Riley Stoker Corp.

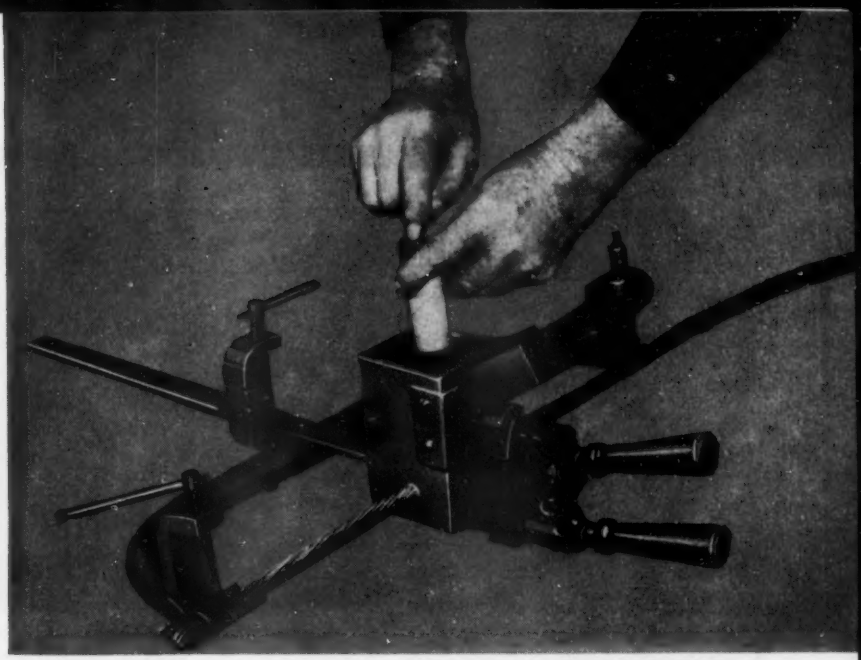
Material was also drawn from: Hard Facing by Welding, M Riddihough; Hard Surfacing by Fusion Welding, H S Avery; Procedure Handbook of Arc Welding Design and Practice, The Lincoln Electric Co; Welding Encyclopedia, T B Jefferson; Welding Handbook, American Welding Society.

For valuable help the author thanks: Bela Ronay, O E Swenson, U.S. Naval Engrg Experiment Station; S A Greenberg, American Welding Soc.

Fast, Permanent Joint With Simple Lightweight Cable-Welding Unit

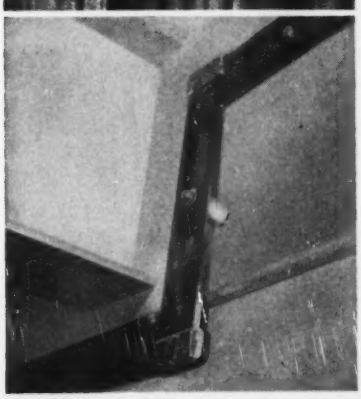


FLINT SPARK ignites powder; molten metal runs through tap hole to weld cables



CHARGE POURED in crucible with the ground cable and terminal strap in jig ready for welding. Completed connection has current-carrying capacity equal to conductor

How to Weld Grounding Cables



FEEDERS on vertical runs may be welded, top photo. Note small diameter of final tape job. Ground bus welded with second crucible that handles rectangular shapes

Powdered metal, firing charge, crucible, spark. Result: high-current capacity joint between copper-copper or copper-steel

► THIS PRACTICAL and simple way of joining conductors is fast finding its place among accepted cable-connecting methods. The method yields welded joints in copper cable and bus bars.

How It Works. The operating principle is simple enough. First, the welder-unit is placed on the conductors to be joined. A firing charge atop powdered metal is placed in the crucible of a graphite mold. Charge is then ignited with a flint gun. Resulting burning produces molten metal that melts a steel disk in the welder unit. Molten mass then flows down onto the conductors, producing a solid copper weld. Welding operation takes but a few seconds.

Powdered metal consists of copper oxide and aluminum. Reduction of copper oxide by aluminum produces molten copper and aluminum oxide slag. Molten copper flows over pieces in graphite mold, welding them together. Slag is easily knocked off after mold is removed.

Applications. Photos on following two pages were taken during construction of the new Far Rockaway plant of the Long Island Lighting Co. Here the welding technique was used on plant grounding network.

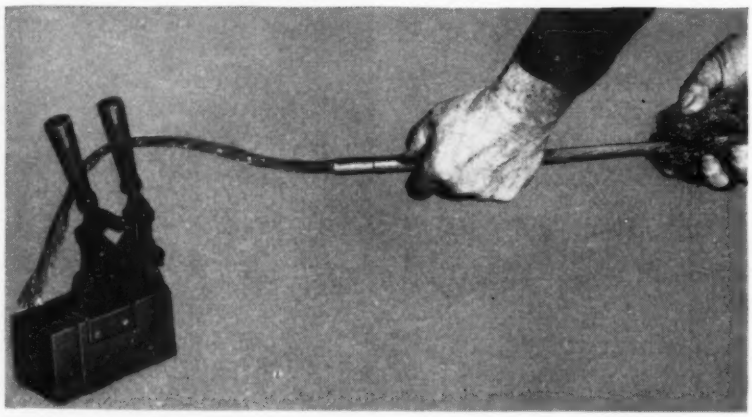
But the method is not limited to grounding conductors. For instance, in the new Statler Hotel in Los Angeles, the many joints in 500-mcm feeders are welded. These are vertical runs; hence welding was done with cables in their final vertical position. Photo to left shows taped-up joints in a pull box.

Another application is welding of ¼ x 4-in. copper bus bars in Sheet and Tin Mill plant at the Columbia-Geneva Steel (Division of U. S. Steel), Pittsburg, Calif. In addition to bus work the technique is being used for cables. Likewise, the bare 500-mcm grounding cables in Contra Costa steam plant of Pacific Gas and Electric Co are welded throughout. Many joints are the T-type with a 250-mcm tap.

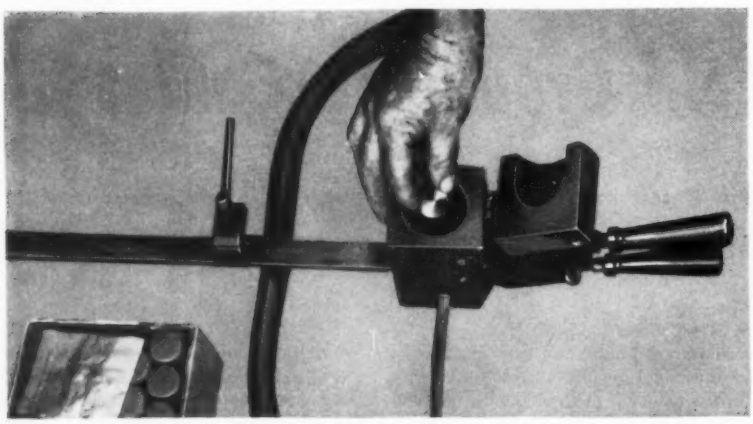
Still another application centered about salvaged submarine cable belonging to Pacific Gas and Electric Co. The PG&E engineers reused the old 250 mcm as grounding cable in substations and power plants. The welding technique was adopted for joining. Each joining point was cleaned with wire brush before welding. Resultant joints were satisfactory even though individual strands were covered with copper sulfate.

Powdered copper oxide and aluminum poured into graphite crucible, then

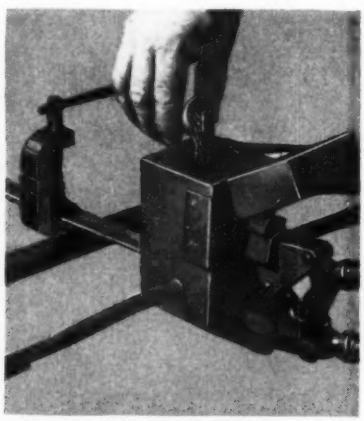
1 Clean parts to be jointed. Where cable is insulated, strip off about 1½ in.



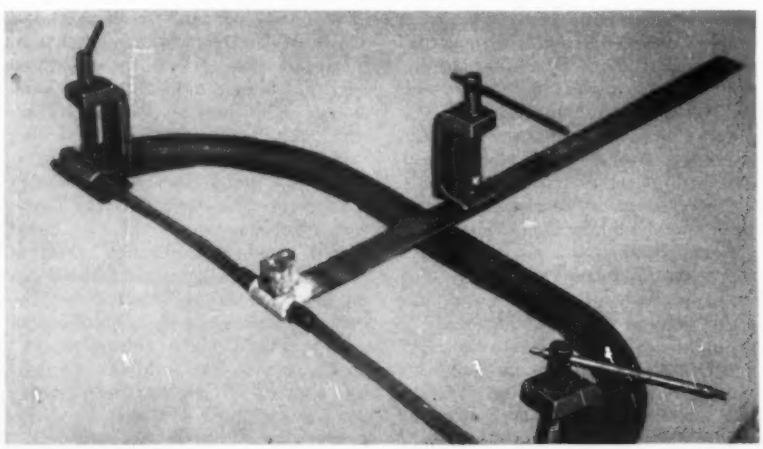
2 Adapter sleeves permit use of one-size welder unit with several cable sizes. Sleeves slip over cable to build up diameter matching openings in welder base



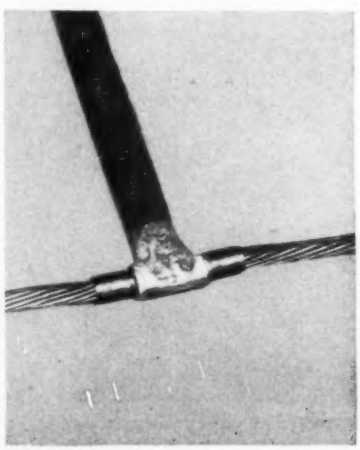
5 After checking that cable ends butt at center of tap hole, drop metal disk into crucible base to cover hole. Disk holds charge in firing chamber till ignited



6 Pour powdered metal (copper oxide, aluminum) and starting powder in unit

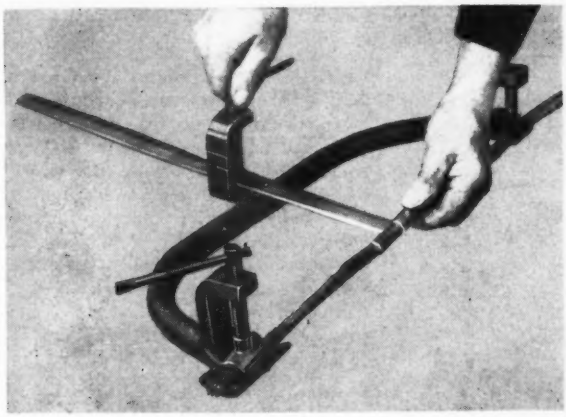


9 Release handles to open welder. Knock off slag formed, then remove cable and strap from clamping rig. No insulation needed since both are in ground circuit



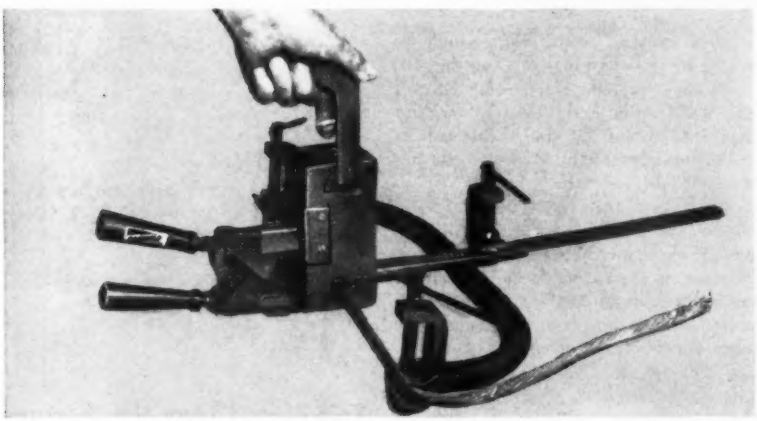
10 Check finished job. Foreign matter in mold will give puffy, porous weld

melted with firing powder, spark gun: molten metal flows over the joint

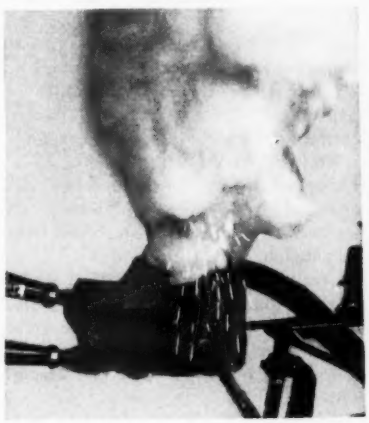


3 Clean grounding strap, butt to sleeved cable. Three-point clamping rig holds cable and copper strap snug for welding

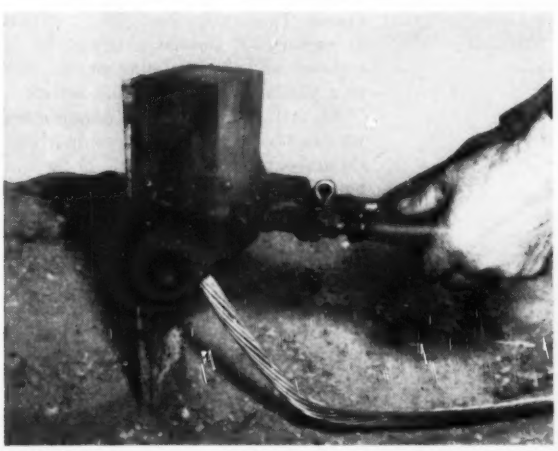
4 Slip welder jaws over butted joint, then snap unit shut. Variety of weld units made to handle many types of joints



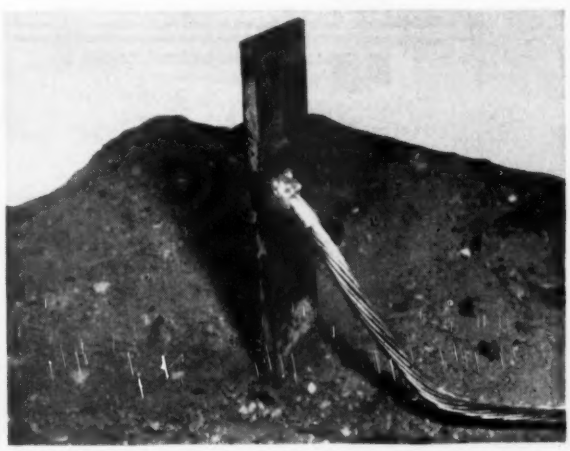
7 Ignite charge with spark gun held close to opening in welder cover. Prepare to pull gun away fast after powder ignites to prevent fouling gun by smoke, flash



8 Expect some smoke and flame to spurt from cover. Let set for about 10 sec

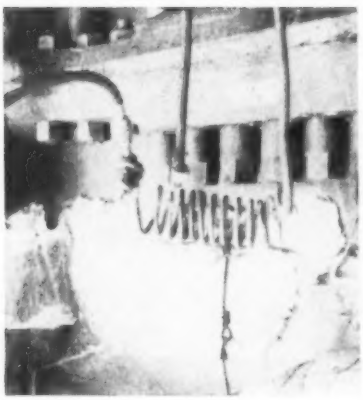


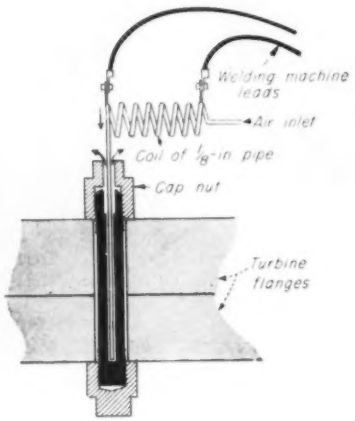
STEEL STRAP and copper cable can be welded with another type weld unit. First, dry wet surfaces with carbon tetrachloride



USE SLEEVES when welding cable smaller than No. 4 to steel strap. Such sleeves will mean added strength at weld point

PRACTICAL IDEAS...*here's the trading post for your*





Heater for Turbine Flange Bolts

ELECTRIC BOLT HEATERS for our turbine flange bolts were not available when we began to dismantle one of our units for inspection. We don't heat high-tensile-strength bolts with an open flame torch.

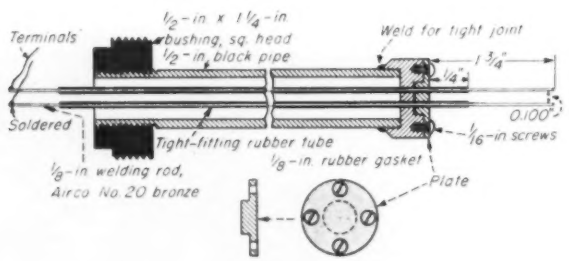
We heated bolts with a coil of 1/8-in. iron pipe as an electric heating element. Low-pressure compressed air passes through hot coil and down into bolt, sketch.

Heating coil is 10 turns of 1/8-in. standard black-iron pipe with inside coil diameter of 3 in. Coil, wound in lathe over a 2 1/2-in. pipe, has spacing of about 1/2 in. between turns. One end of coil is left straight, and long enough to reach bottom of 14-in.-deep hole in bolt.

To lugs welded to both ends of coil are leads from a dc electric welding machine. About 250 amp heats coil to a dull red, with air at 5 psi passing through coil and into bolt.

Superheated air heats bolt as it escapes from bottom of heater pipe and passes back up through bolt. It took 20 minutes of heating to elongate bolts enough to permit nuts to be easily removed. Bolts were heated in same way when reassembling machine.

C TRETINYAK *Austin, Minn.*



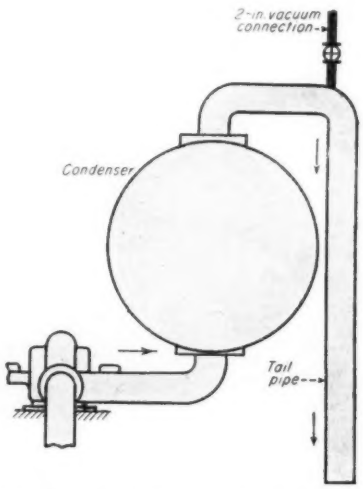
Making a Conductivity Cell

OUR CONDUCTIVITY CELLS gave trouble, so I made a cell from welding rod and half-inch pipe, sketch. This works better and needs little maintenance. Only upkeep is cleaning electrode tips in weak acid solution. Also resetting the 0.100-in. clearance, which may vary with application.

Cell is easy to make. First make shell. Lightly screw in plate with rubber gasket. Slip rubber hose over welding rod, leaving an inch hanging over end. Place another rod with hole in end, run wire through hole, slip assembly into overhanging hose. Secure rod to hose with wire. Push leading rod through holes in plate and gasket. First soap rubber hose so it slips through easier. Then pull leading rod through with hose and electrode. Cut hose and move electrode out 1 3/4 in. Tighten plate and trim hose to 1/4 in. If electrodes are long, file down. After soldering terminals, cell is ready for service. You place a rubber stopper with two holes. Make holes larger than rubber hose over electrodes in cell's top to hold electrodes in place.

Another way to seal cell's bottom is to coat inside of plate with GE Glyptol. If this is used, cell must be left to dry at least 24 hr before using.

G J TROSKE *Galesburg, Mich.*



Tail-Pipe Clean-Up System

WE NEEDED a vacuum clean-up system. Condenser tail pipe on our 10,000-kw machine had a 15-ft drop, so we made a 2-inch pipe connection to upper ell, sketch. This gave an excellent vacuum at expense of an extra pound or so pressure on our circulating pumps, due to a partial loss of siphoning action.

As turbine operation is continuous, we extended piping to various locations throughout plant. One length of flexible hose is enough for all plant cleaning.

System has been operating for years and is highly satisfactory. Dust and dirt collected is automatically discharged with circulating water.

J A SWANSON *Princeton, B.C.*

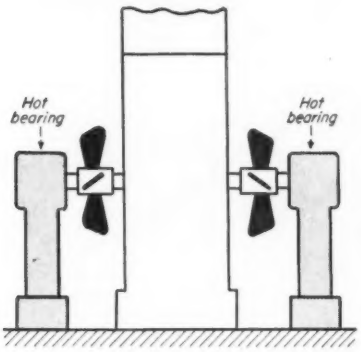
Timer for Chemical Feed

INSTALLATION of 15-minute timer on chemical feed pump results in added savings for power and maintenance. Besides, it does not alter concentrations.

L FITZPATRICK *Jefferson City, Mo.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*

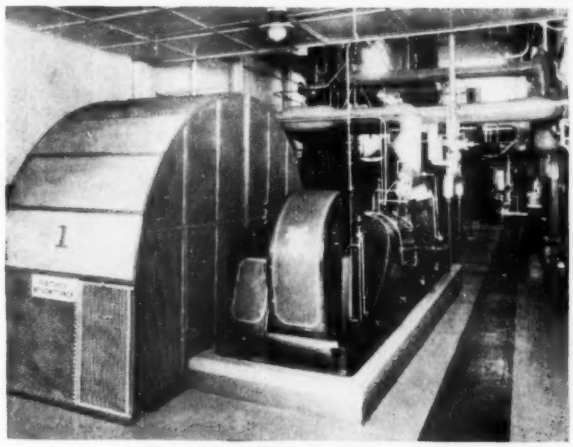


No More Fan Bearing Troubles

BEARINGS of large induced-draft and secondary air fans are usually water-cooled self-aligning bearings to cut down wear on sleeves. In smaller fans in medium-output boiler plants, bearings are ring-oiled and watercooled, even for ball bearings. Even then, bearings may overheat.

In one plant we had trouble from fan bearings overheating. This was overcome by fixing a disk, with a number of blades attached, to fan shaft between each bearing and fan sketch. Fan dissipated heat before entering the bearings. That solved our problem.

T H CARR *Shipley, England*



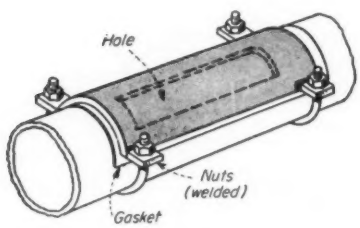
Lighten Up Dark Engine Rooms

HAVING OPERATED or managed 100 ice plants in my time, I have learned that painting engine rooms white is a good investment. It not only lightens up everything, but also cuts down accidents.

Photo shows overhead, walls, some machinery and also the floor painted white. At one time this was a dark engine room. Now only the path along floor is dark.

Employes stay longer in a clean, light plant. Then again they naturally take better care of it. That cuts down maintenance bills and outage. There is no reason why a plant cannot be kept as clean as your own home or office.

H C WELCH *Baldwin, N. Y.*

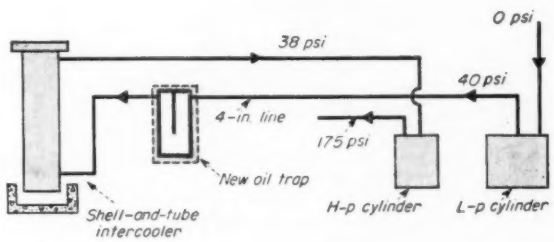


Removable Clamps Serve as Clean-Outs

WHEN LARGE DRAIN or iron sewer line is plugged, here's a quick way to clean out obstruction, especially if there are many fittings. Where line is hard to get at, we cut a hole in pipe's top section, 6 to 8 in. long, sketch. We then make up a clamp by either sawing or cutting lengthwise a pipe of same diameter a few inches longer than cut made in pipe.

Nuts are welded or brazed at each corner of clamps. Rods are made up and bent to curvature of pipe, gasket inserted, clamp pulled up and bolted.

A ROCKLIN *Chicago, Ill.*



Oil Trap Stops Metallic Noise

ONE OF OUR 2-stage, direct-acting, horizontal, high-speed ammonia compressors is rated at 150 tons at 0-psi suction, and 0 F superheat at 175-psi condensing pressure. Machine needed an intercooler to reduce valve maintenance, oil consumption and power cost.

Intercooler was installed a great distance from machine because of water-supply system. After installation there was a severe metallic hammer at frequency corresponding to compressor valve opening. Noise caused complaints from operators, we all worried about piping. We first contacted makers.

Compressor and intercooler maker's field engineers could offer no economical solution. We installed an oil trap, sketch, to protect intercooler surface from oil, which would cause poor heat transfer. We oversized trap and insulated it with hair felt in hope that shock waves causing hammer would quiet down. Hammering decreased and pipeline vibration stopped. Also, a much steadier pressure was noted back in suction to high-pressure cylinder. This helped increase h-p cylinder efficiency.

M EVANS *Chicago, Ill.*

(*Continued on page* 128)

Begins on page 126

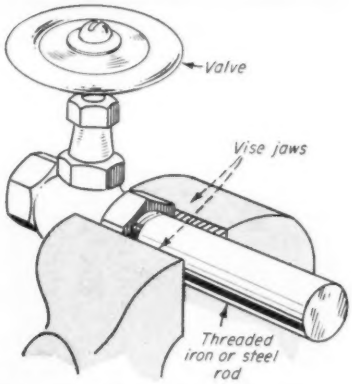
Solvent Drum Is Handy, Speeds Work

ALL PLANTS use some kind of solvent for cleaning parts. But a safe solvent recommended by National Safety Council is Stoddard's solution.

Photo shows a handy container. This is a 50-gal oil drum cut in two and fitted with perforated tray. For cleaning parts, brush is dipped into solvent and worked into piece to be cleaned. Or parts are attached to wire hook and dipped into solution. Solvent drips through tray, back down into drum, without making a mess on floor.

When not in use, brush is kept on tray and hinged lid is closed. Because it's always ready for use, not only is time saved, but also everyone knows exact location in maintenance shop.

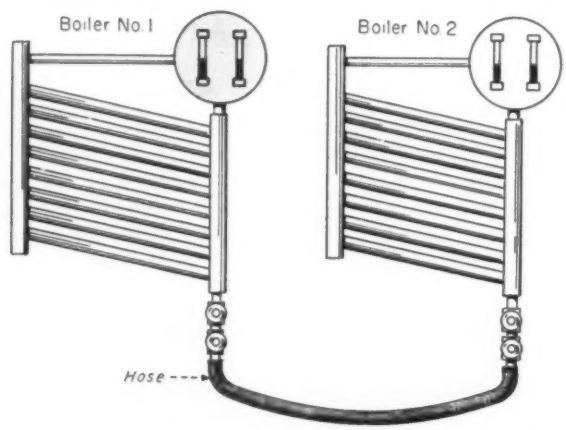
BILL DAVIS
National Safety Council, Chicago, Ill.



Brass Valve Saver

WHEN DISASSEMBLING or assembling brass valves, or any other valves or similar devices having pipe thread connections, the danger of distortion or of crushing threaded portions can be minimized, as shown. Screw a short length of iron or steel rod of suitable diameter and pipe threaded into valve connections before the valve is clamped in a vise. The solid stock will not crush.

T TRAIL *Catonsville, Md.*



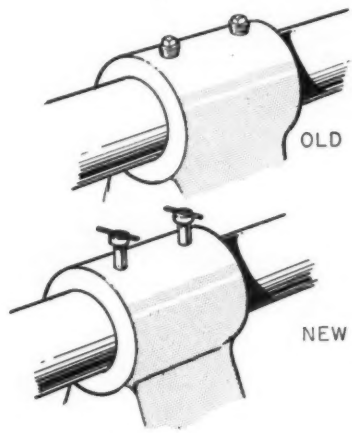
Emergency Equalizer Checks Water Level

ASME CODE for power boilers does not require gage cocks on boilers having two gage glasses at same level.

Both gage glasses seldom become obstructed or break at same time. But it did happen in a plant operating two such boilers in battery. Both glasses on boiler No. 1 broke by accident and we had no new glasses in storeroom.

Both boilers had to be kept in operation, but it had to be done safely. A flexible steam hose was handy, so we connected to blowdown line of each boiler as shown. By opening blowdown valves of both boilers, water level in each equalized. Water level of each boiler was checked by No. 2 glasses.

F E SMITH *Canton, Mass.*



Nipple and Cap Keep Out Dirt

WE INSPECT bearing oil-rings on our auxiliary equipment twice each shift. Inspection holes were originally plugged with standard pipe plugs, but dust got into oil each time plugs were removed. In a short time bearing oil became fouled and had to be changed.

To stop fouling, short nipples were installed in holes and caps screwed on top end. Caps are now removed to inspect oil rings. We find it is now easy to prevent dirt and dust getting into oil.

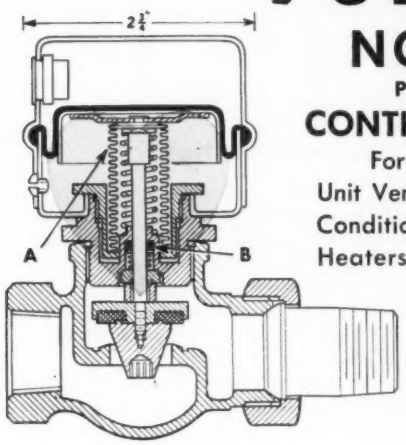
J A SWANSON *Princeton, B. C.*

(*Continued on page* 130)

New!

Look what Powers has done to **Modernize** Control Valves

Powers NO-PAK Valves Banish Packing Maintenance
Prevent leakage of water or steam or loss of vacuum



POWERS

NO-PAK

Pneumatic

CONTROL VALVES

For Convectors, Unit Ventilators, Unit Air Conditioners, Baseboard Heaters, Radiators, etc.

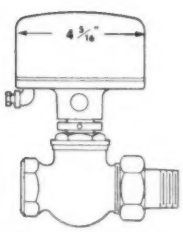
Various Types and Sizes for all requirements

Another POWERS Contribution to Better Heating and Air Conditioning Control

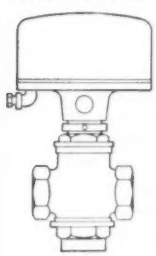
NO-PAK valves with their many advantages are now standard with Powers temperature control systems. Their superior performance is due to Duo-Seal construction.

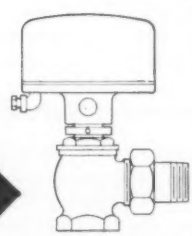
Bronze Packless Bellows (A) in sectional view above, is the primary seal which eliminates packing maintenance — packing friction — steam and water leakage or loss of vacuum. It is designed to withstand pressure up to 150 psi. Maximum valve stroke is only two-thirds of the normal bellows stroke. A spring loaded secondary seal (B) permits servicing of valve top without draining the water system or shutting down the steam heating system. Seal is made of highly elastic neoprene and is ready to act at any time. Small contact between seal and the highly polished stainless steel stem makes friction a negligible factor.

For utmost dependability and lowest cost maintenance specify control by Powers NO-PAK Valves.

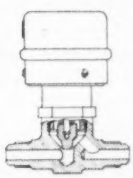


Straightway Union
3-Way Screwed Ends

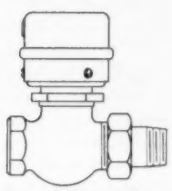




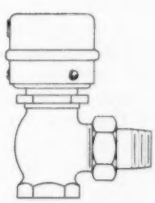
Angle Union



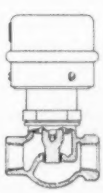
Flared Ends



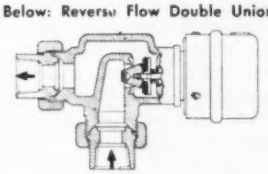
Straightway Union



Angle Union
Screwed Ends



Below: Reverse Flow Double Union



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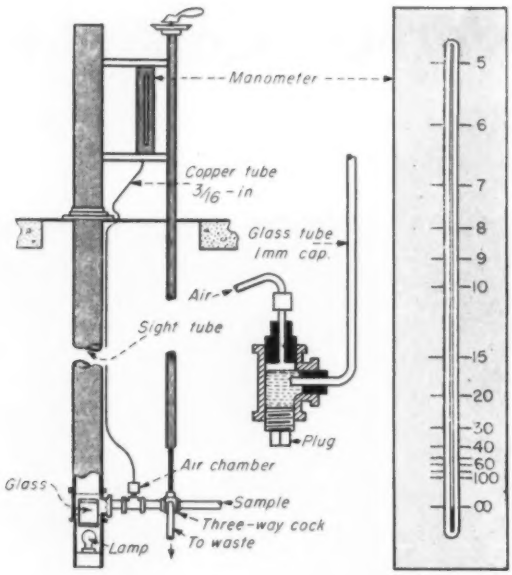
Begins on page 126



Turbidimeter for Water

MEASURING TURBIDITY is important in all plants treating turbid waters. Instrument shown here has these advantages: (1) rugged construction, good for everyday plant use—no glass tubes to handle or break (2) covers turbidity range of most use to water-clarification plants—5 to 100 ppm. (3)—easy to use, requiring no special skill.

Instrument shown is on Jackson turbidimeter principle. Namely, depth of turbid water required to obscure a light varies inversely as turbidity. Tube, 12-ft-long 2½-in. iron pipe with glass bottom attached, is long enough to read turbidities as low as 5 ppm.

Tube is filled and drained by passing water through a 3-way cock, operated by extended stem and handle shown. Lamp is clear glass, 25-watt bulb with a C-shaped filament. In use, water is admitted to tube until C-shape of filament just disappears in haze from turbidity, as seen from tube's top. Water level may be raised or lowered to find this point accurately. Depth of water in tube is measured by manometer, which is calibrated to indicate turbidity directly.

Two small details are important: (1) Raise glass bottom in tube enough so water won't stand on it when tube is drained empty — otherwise, it fouls quickly with sediment. (2) Make connection for manometer to small air chamber shown, with volume of about twice manometer tubing.

If directly connected without this chamber, water rises in tubing as turbidimeter tube is filled. Then subtract pressure of this water column from mercury manometer reading. With chamber of right cross section, this water-level rise is negligible.

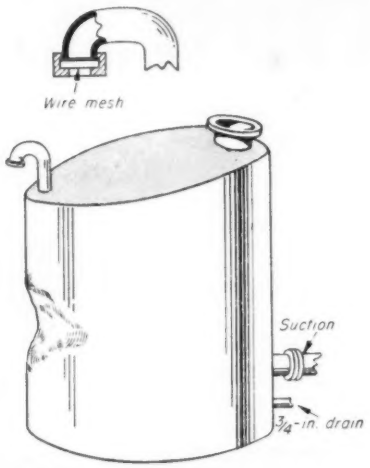
Mercury manometer has single leg to obtain maximum length of scale, other leg being a large pool of mercury whose level does not vary much. Central figure of sketch shows manometer details, using capillary tubing of 1 mm bore and 1-in. iron tee for reservoir.

Scale is calibrated from following table, measurements being made from mercury position in capillary tube when turbidimeter is empty. Right-hand sketch is scale drawn half-size.

Table to Calibrate to Scale

Turbidity ppm	*Inches*	*Turbidity ppm*	*Inches*
5	10.50	20	2.60
6	8.75	22	2.40
7	7.50	24	2.25
8	6.60	26	2.10
9	5.85	28	1.95
10	5.25	30	1.80
11	4.75	35	1.60
12	4.35	40	1.41
13	4.00	45	1.22
14	3.75	50	1.15
15	3.50	60	1.00
16	3.35	70	0.88
17	3.15	80	0.78
18	3.00	90	0.70
19	2.80	100	0.63

D H MATHESON *Hamilton, Ont.*



Believe It or Not

THIS problem is unusual, not only because it seems impossible, but also for the way it was corrected. Two fuel-storage tanks, of 80,000 gal each, were made of usual type of light metal. They were built in yard on cement base and surrounded by cement wall about five feet high.

Fitted with steam heating coils and usual manhole and vent on top, tanks were in service for years. Heating coils in one tank had been leaking for some time. Water coming in with oil caused spluttering and uncertain steam conditions. It was December, so making repairs was not convenient. We would wait until spring.

One day, coming on duty at 4 pm. I could hear steam blowing into 120-F oil in tank. I closed steam valve. Tank was about a third full of oil.

About four hours later the burners began to splutter and the fuel pump lost suction. I went to the yard to change to other tank, which was in good condition. But I found tank in service had collapsed on one side, sketch. Dent was about 18 in. deep by 6 ft across.

Condensation in tank and pump suction had caused a vacuum high enough to push side in as shown. But how was this possible with a 3-in. gooseneck vent and a manhole plate lying loose on the gasket? What's your explanation?

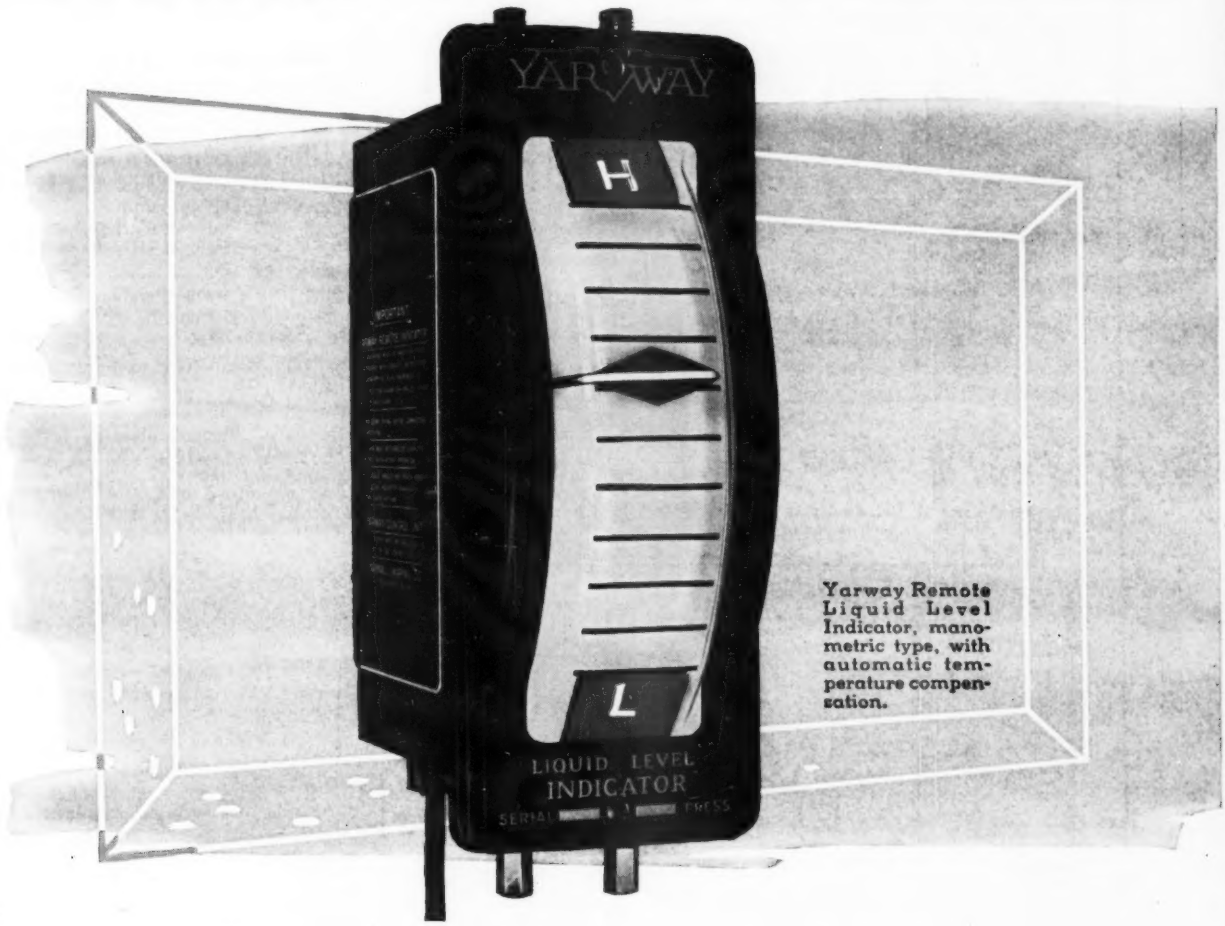
G MCNALLY *Kearny, N. J.*

Commercial Solvents Safe

HYDROCHLORIC ACID is cheapest scale remover. However, commercial scale solvents with inhibitors offer added convenience, also safety because of scientific blending. Small difference in cost is offset by safety to metal and worker.

L FITZPATRICK *Jefferson City, Mo.*

What's New
IN BOILER WATER LEVEL INDICATION?



Yarway Remote Liquid Level Indicator, manometric type, with automatic temperature compensation.

IMPROVED *WIDE VISION* REMOTE LIQUID LEVEL INDICATOR

A new-type face on the Yarway Remote Liquid Level Indicator now permits side as well as head-on dial readings. This vastly improved visibility makes it possible to check boiler water levels from most any position in the control room, or wherever the Yarway Remote Indicator may be installed.

MANOMETRIC TYPE

The Yarway Indicator is a manometric type with automatic temperature compensation. Level readings are instant and accurate because the indicator is operated by the boiler water itself. The indicating mechanism is never under pressure. There are no stuffing boxes.

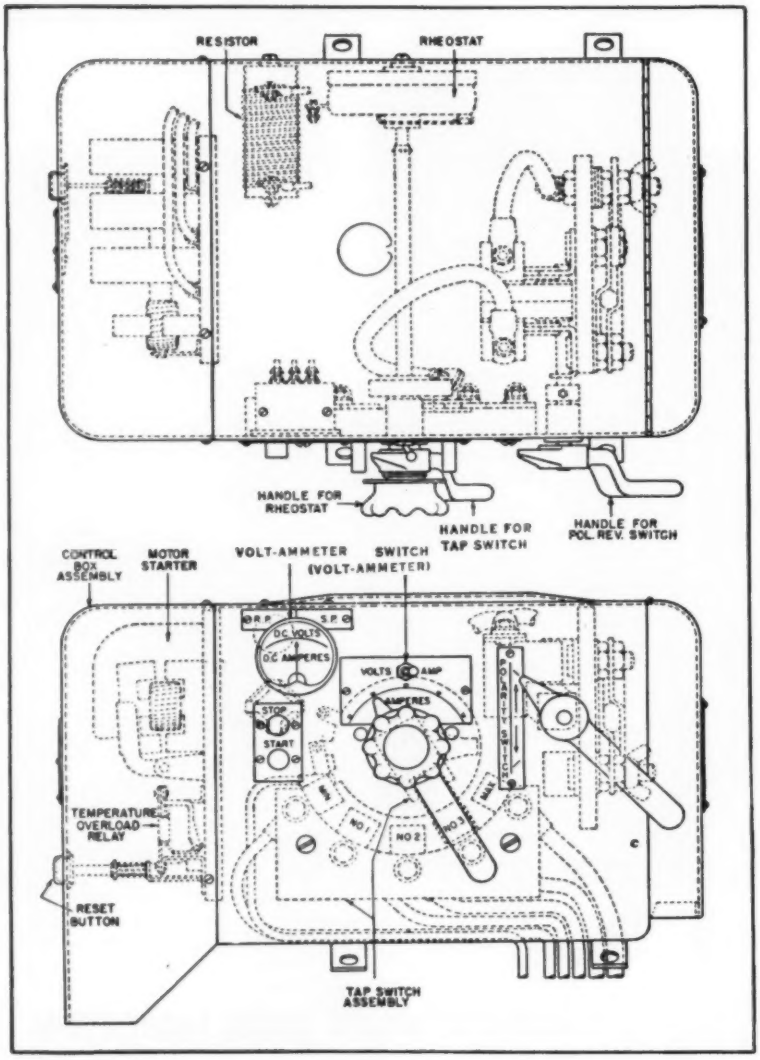
Over 8,000 Yarway Remote Liquid Level Indicators are successfully operating throughout industry—primarily for indicating boiler water levels, but also for many other liquid level applications, and for superheater pressure differential indication aboard ship.

For full information on Yarway Indicators, write for Yarway Bulletin WG-1823.

YARNALL-WARING COMPANY • 100 Mermaid Avenue, Philadelphia 18, Penna.

YARWAY *STEAM PLANT EQUIPMENT*

PLANT PROBLEMS... *put your know-how to work*



Why Does Welder Overheat Rods?

HERE ARE THE FACTS: We have two 200-amp 40-v arc welders driven by ac motors. One is a year old, the other six years old. Neither welder has an ammeter.

Lately our older machine overheats small rods. Even ⅛-in. rods get red hot, and we must throw them away when half used. The only work I ever do on units is to clean them, replace brushes.

Checking machine terminals with a voltmeter showed 100-v open circuit, 50 v with job selector at lowest setting. With electrode holder clamped to ground, voltage is 0 at lowest job setting, 0 v at highest. Middle setting while machine is welding gives 25 v.

Why is output 100 v instead of 40 v? New machine tests the same as old but doesn't overheat rods. Why? What are good tests I can make on the machine?—*MT, Dec Power*

Here Are the Answers

CHECK CONTROLS for worn and shorted parts that may be allowing too much current to enter welding circuit. Sketch shows a typical control box and its parts.

Here are some general pointers that pay off in any welding shop serving an industrial plant.

In general, never leave electrode holder grounded. If set is to be idle for some time, shut off motor. Clean windings once a week if welder runs under dusty or dirty conditions. Use a vacuum cleaner or air at 25 to 30 psi. Where machine is subjected to highly abrasive materials like cast-iron dust, don't use compressed air unless its pressure is very low. Vacuum cleaning is better. Use filters on welding sets run in dusty atmospheres for long periods.

Test insulation resistance every four months and record the values you read. If insulation resistance falls rapidly, you know set is (1) overloaded (2) running in too hot an area (3) attacked by harmful vapors or (4) subjected to other injurious conditions.

After you check set windings, inspect brushes and replace worn ones. Clean dirt and dust from brush holders. See that brush shunts are securely fastened and brushes do not stick.

Set holder about ⅛ in. above commutator. Be sure spring of brush holds it firmly against commutator and spring moves freely.

Clean commutator with lint-free cloth. If commutator is grooved, turn down slightly and then undercut mica. *MT* may find commutator is a bluish or reddish color, meaning that set has overheated. Sand commutator lightly with 00 sandpaper. Polish with a fine stone, not emery.

Clean motor starter thoroughly. Be sure rheostats are clean, with windings and contacts in first-class condition. Check to see that arm moves freely.

Tighten all bolts on polarity and tap switches. Clean switches and check blades; they should be free of burrs.

Adjust blades so they make firm, positive contact.

Look for damage to welding studs caused by swinging cables or burning from poor connections. Check welding leads for damaged insulation, exposed wire, or loose connections. Be sure leads are large enough to handle welding currents used. Attach securely to terminals.

J C Taylor *New York, N. Y.*

For more answers, turn to p 134

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*

How Shall I Set Up Heating Records?

Another answer to Problem No. 2 in November Power

THE FACTS: I run a coal- and oil-burning heating plant with eight boilers. Our 20 buildings house 4000.

With such a large load, efficiency, fuel costs, weather are important. Management checks expenditures closely and I'd like to show why and where every dollar is spent.

How do you set up records that correlate weather, fuel consumption, efficiency, etc? What are best data to collect? Are records worthwhile if they require much work?—*CB*

RECORDING-INSTRUMENT CHARTS are one of your best guides to heating-plant operation. I've sketched a few charts to show what typical troubles look like when they pop up in your plant.

Heater final temperature, when right, shows up like that in *A* for a steam system. Chart *B* is abnormal, condensate temperature being lower than when plant functions properly. Supply temperature is also lower.

Return-pump charts show duration of each run and quantity pumped. Chart *C* is normal, that at *D* abnormal. In *D* the pump is handling too much water, as shown by the long runs.

Boiler charts, E and *F,* show that the difference between a steady heating load and a fluctuating one caused alternate heavy and light loads. You get a chart like that at *F* when all thermostats in the plant call for heat at the same time. Chart at *E* is obtained when only a few thermostats cut in at once.

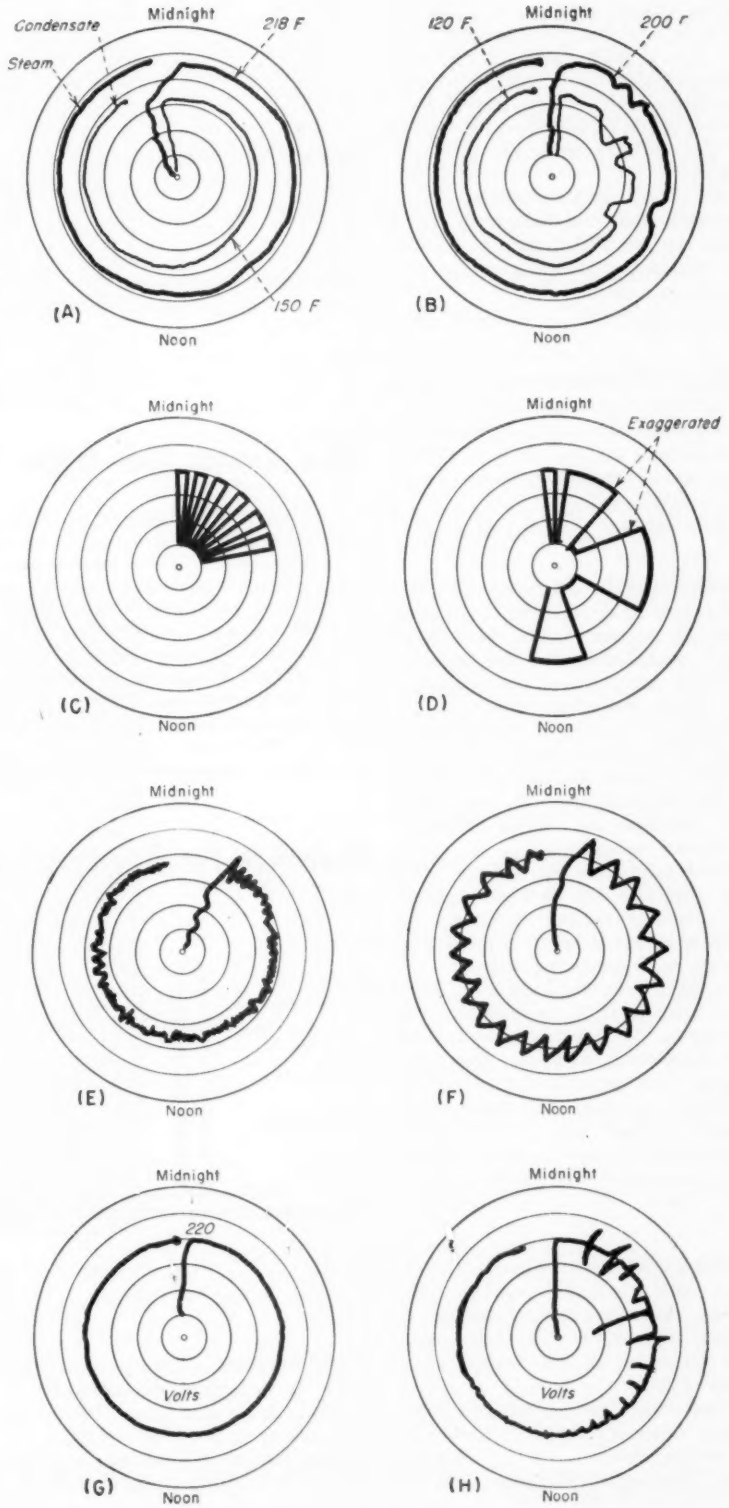
Electric power charts, G and *H,* show normal and abnormal conditions. Chart at *H* results from a severe electrical storm and static surges.

Recording-instrument charts form a good base for heating-plant records. Learn today what chart readings mean in terms of plant output, load and condition of your equipment.

Charts backed up with heating-zone meters are an excellent key to what goes on inside the supply and demand sections of your plant or building. They help you show management where and why you spent money.

TOMMY JAMES *Verdun, Canada*

TURN TO page 136 for your two new problems from *Power* readers



More PLANT PROBLEMS

Begins on page 132

BALANCE THE LOAD when more than one welder is hooked into a circuit. With two dc sets on the same line, one set up for straight polarity work and the other for reverse (holder positive), you run into a 160-v circuit if maximum allowable open-circuit voltage for each machine is 80 v. You complete this circuit when you contact uninsulated parts of the electrode terminals, cables or holders.

MT should check his welding circuit, especially rods and holders to see if there are shorts that may be causing his overheating. That's where he may find trouble source.

T LEE MACK *Chicago, Ill.*

WRONG ELECTRODES for current values being used may cause *MT's* trouble. Check current recommendation of rod manufacturer to see if it is within the range used. Too high a current setting may overheat the rods.

JOHN BENNING *New York, N. Y.*

CHECK POLARITY of welding current to make sure it is right for rods used. Electrode negative is best for bare or lightly coated electrodes because a little more heat is generated on positive side of circuit with this type.

Adding a coating to the electrode forms gas in the arc, which alters heat conditions so greater heat is produced on the negative side. But remember, heat conditions are effected differently by various coatings.

One heavy coating may give desirable heat conditions with electrode negative, while another coating on same electrode may have a more desirable heat balance with electrode positive.

Designer decides polarity to use with any electrode. If *MT* is in doubt about polarity to use with any electrode he can check the melt-off rate. Melt off 6 or 8 in. of an electrode with each polarity, keeping a record of the time needed. Longer melt-off time usually gives greater heat in plate or joint. Such a test is accurate enough for most jobs.

L C KANE *Denver, Colo.*

EXCESSIVE CURRENT overheats any electrical device, including welding rods. It can also cause major damage to welder, especially if there is no overload protection. Don't use welder while defect exists.

Check current settings on dial pointer with an ammeter temporarily hooked to the welding line.

L E POLIKOFF *Brooklyn, N. Y.*

AWS Recommendations for Welding Plain-Carbon Steel

AWS classification	Deep penetration	Poor fit-up	Finish pass on deep-groove work	For steels with tendency for: Weld cracks	Internal porosity	Surface holes
E6010	x				x	
E6011	x				x	
E6012		x		x		x
E6013		x		x		x
E6013		x				
E6030	x				x	
E6020	x		x		x	

CONTROL VOLTAGE with setting on machine. Use high voltage but low current on thin metals so arc won't burn through metal.

High current will be needed on an overhead job to get enough penetration with sufficient arc force to help push the metal up. Use a high current to weld a casting; voltage may be low.

Choose electrode correctly. Table gives American Welding Society recommendations for electrodes used for welding plain-carbon steel.

BEN MASENDALE *Dallas, Tex.*

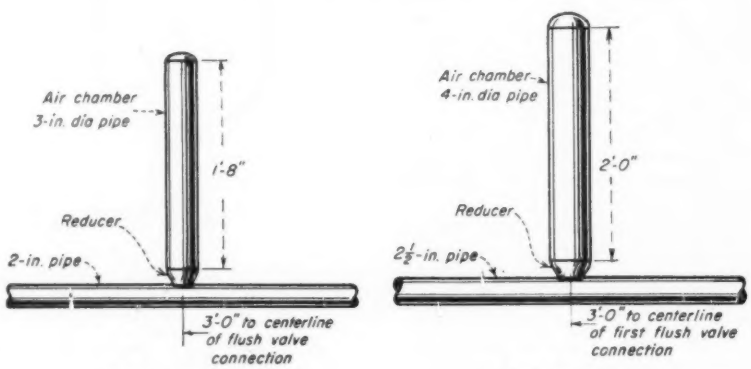
What Causes This Water Hammer?

HERE ARE THE FACTS: Every time flush valves in our sanitary lines are opened we get a sharp knock in the pipes, sketch p 152, Dec *Power*. We've tried suppressors at points shown but shock wasn't reduced. Hammer isn't common type from sudden halting of liquid flow. Instead, it is a reverse shock opposite to flow direction. It makes pipe move about ½ in.

Shock seems to be independent of flow, and there are no shock waves following the initial one. Reducing flow at flush valves cuts shock somewhat, but not completely. All pipes are clean, without internal obstructions.

What's best way of stopping these shocks? Do we need more or larger suppressors? Should we change piping?—*CH, Dec Power*

Here Are the Answers



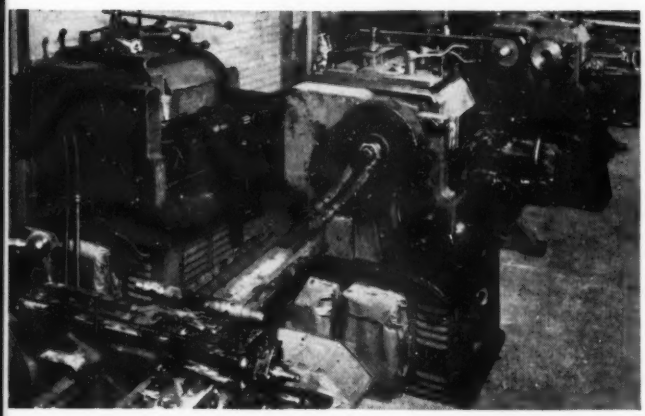
SMALL AIR CHAMBER LARGE AIR CHAMBER

WATER HAMMER in *CH's* sanitary lines comes from intermittent stoppage of flow through the flush valves. Decreased flow reduces shock in the piping.

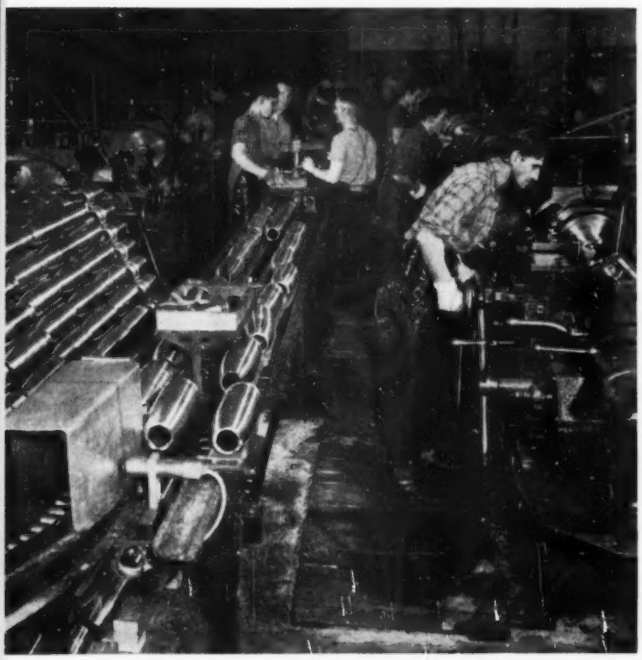
Water hammer is a series of pressure pulsations above and below normal pressure in line. Pulsations start when the moving fluid is suddenly stopped. Noise we hear comes from pulsations.

Several ways of relieving high pressure accompanying water hammer are: (1) spring-loaded relief valves that open

DEFENSE PLANT DE-MOTHBALLED FAST WITH THE HELP OF TWO SUN PRODUCTS



BEFORE: The machinery in this Navy-owned shell-making plant stood idle—coated with a rust preventive—for 5 years after World War II. When asked to reactivate the plant in three months, the U. S. Hoffman Machinery Corporation anticipated a complete machinery teardown for cleaning, because the rust preventive had seeped into the working parts.



AFTER: No teardown was needed. Sun Spirits did the external cleaning job and the detergency of Sunvis H.D. 700 Oils the internal job—cleaning out parts and freeing hydraulic systems. Thanks to the effectiveness of these products, the job was completed and the plant put in operating condition within the three months specified by the Navy.

Recently the U. S. Hoffman Machinery Corporation was asked to reopen a World War II Navy-owned shell-making plant and start production in three months. The machinery, idle for 5 years, had been protected by an external layer of rust preventive. Headstocks, gear units and hydraulic lines were among the parts coated, and unfortunately some of the protective material had seeped into them. It looked as if the machinery might have to be torn down to be cleaned.

Hoffman invited Sun and several other oil companies to survey the machinery and suggest cleaning methods. The company chose Sun's recommendations on the basis of their soundness, as well as on Sun's record for reliable service in other Hoffman plants. The Sun products used eliminated the need for any dismantling. Sun Spirits did the external cleaning job. Sunvis H.D. 700 Oils freed up the hydraulic systems, many of which were extremely sluggish; the detergency of these oils flushed away every last trace of sludge and rust preventive.

Throughout the entire cleaning and recharging process, Sun representatives stayed on the job. As part of Sun's regular service, they trained the oilers, helped work out an inventory control system, and set up lubrication schedules. The terms of the Navy contract were met, and vital defense production was started on schedule. In the year and a half that has since elapsed, there have been no machine failures traceable to poor lubrication.

SUN OIL COMPANY, Dept. P-3
Philadelphia 3, Pa.

☐ I would like to consult with a Sun representative.

☐ Please send me a copy of "Sunvis H.D. 700 Oils."

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Title_____

Company_____

Address_____

City_____ Zone_____ State_____

TECHNICAL ASSISTANCE AVAILABLE. Sun's engineers are at your service for consultation on any matters concerning hydraulics, lubrication or metalworking. It will pay you to utilize the broad experience they have gained in solving a wide variety of lubricating and processing problems in many different industries.

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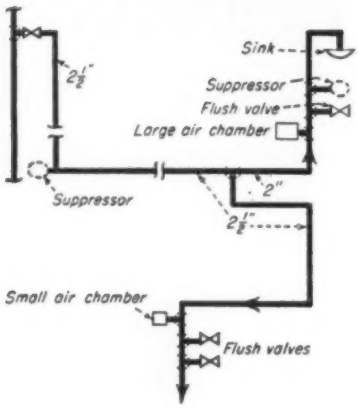
More PLANT PROBLEMS

Begins on page 132

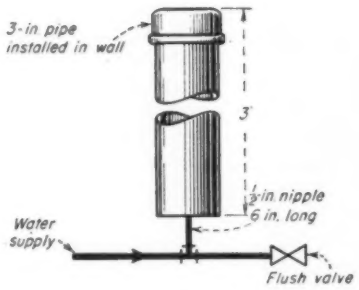


when line pressure becomes excessive (2) metallic bellows that expand when pressure rises (3) flexible containers filled with gas that is compressed by a pressure rise. All these devices are effective when applied right.

One common and cheap way of solving water-hammer problems in the plant is with air chambers, shown in sketches above. With flow rate of 7 fps and static pressure of 25 psi, shock pressure is about 425 psi. Shock-wave velocity is about 4400 fps for line sizes in *CH's* installation. Wall thickness of his piping is sufficient to withstand the shock.

Air chambers having the dimensions shown and located as detailed in piping sketch do a good job. Recharge the chambers periodically because the trapped air dissolves in the water.

A J Breugelmans *New York*



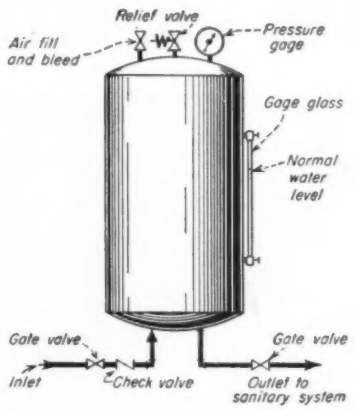
SUPPRESSOR, installed in wall behind flush valves, as in sketch, does a good job. Be sure there is air in it at all times. Results are good.

John D Phillips *Dayton, O.*

CUSHION CHAMBERS at each dead-end of the piping system help reduce noise. If these don't help, install vibration dampers or short sections of flexible hose at random points to break up the continuous lengths of pipe. Don't place anchors too close to dampeners or flexible hoses.

From *CH's* description it looks as though his flush valves close too quickly. Lowering inlet pressure or adjusting valve is one way of preventing this trouble in the future.

Melvin Evans *Chicago, Ill.*



ADJUST FLUSH VALVES to close slowly and almost all or all water hammer will end. Most flush valves close rather sharply and there isn't too much you can do about it in some designs.

CH can obtain a positive cure by installing a pressure tank of about 150-gal capacity on the inlet to sanitary system, sketch. Keep tank about 2/3 full of water and about 1/3 full of air. Air absorbs reverse-flow shock, may be fed into the tank from the plant compressed-air system, if desired.

John J Geist *Brooklyn, N. Y.*

MAXIMUM SHOCK occurs at flush valves and faucet when valves close and flow suddenly stops. Best place to cushion shock is in the branch lines just ahead

(*Continued on page* 220)

YOUR NEW PROBLEMS FOR MARCH

1 Is This Stack The Right Size?

The steel stack for our new boiler is to be 50-in. dia, 150-ft height above boiler-room floor.

Boiler is rated at 20,000 lb per hr, 125 psig, 353 F. Feed temperature is 212 F, gas leaves boiler at 585 F. There is no heat recovery. CO_2 leaving furnace is 14%, leaving boiler 13.5%.

Losses expected are: dry gas 12.5%, H_2 and moisture in pulverized-coal fuel 4.8, moisture in air 0.30, unburned combustible 1.5, radiation 1.2, unaccounted for 1.5%.

Guaranteed boiler efficiency is 78.4%; average draft loss through boiler is 0.60 in. H_2O, required draft at entrance to first pass 0.15 in. H_2O, furnace draft needed at minimum rating 0.05 in. H_2O.

Proximate fuel analysis is: moisture 2.88%, volatile 36.0, carbon 52.36, ash 8.76%.

I don't think stack size recommended to us is right. Have *Power* readers ever run into a problem like this? What's best way to check stack size? Is size recommended correct?—*GK*

2 Why Is Diesel Piston Worn?

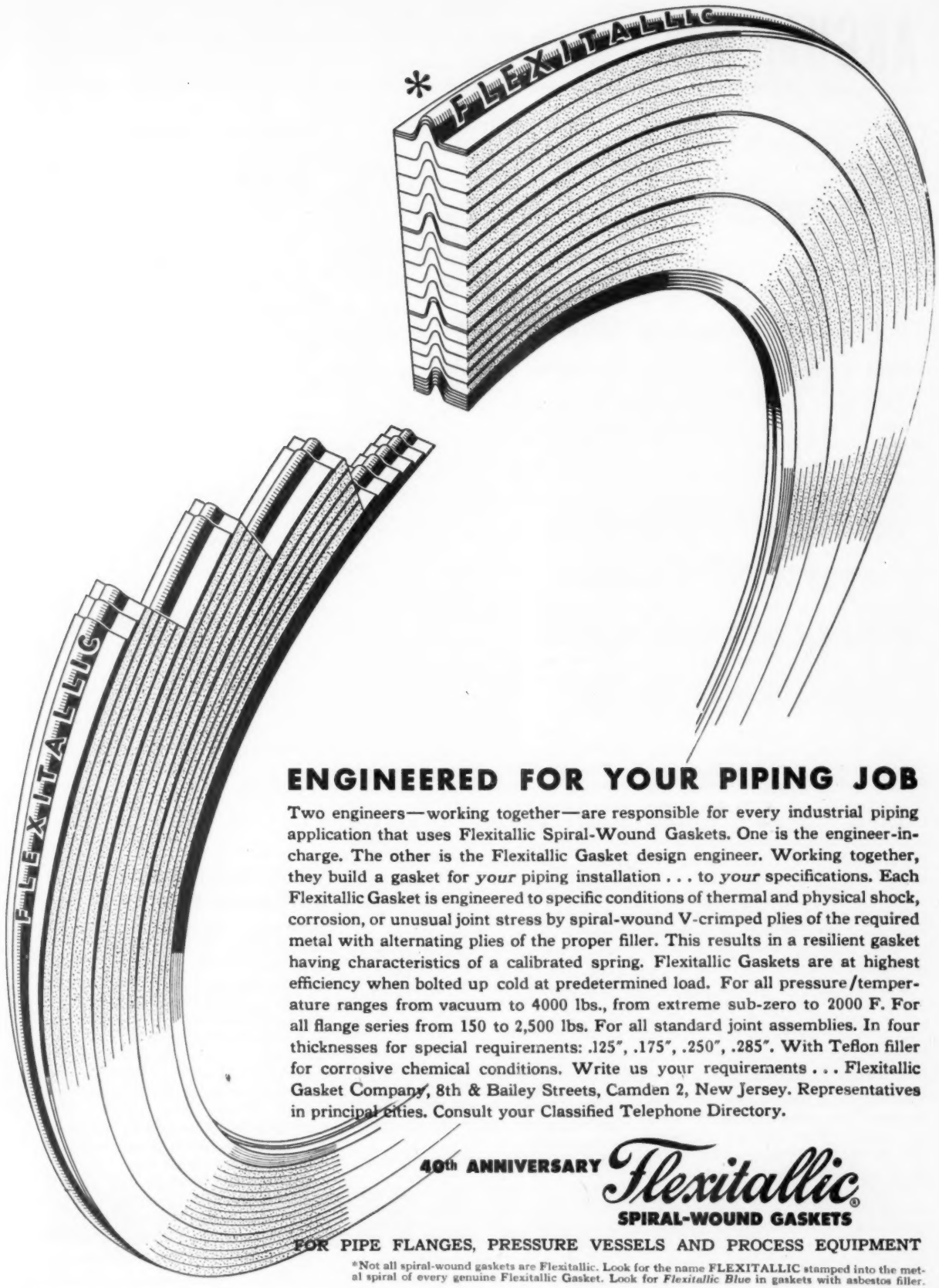
One piston of our 4-cycle 8-cyl 1000-hp diesel is worn oval about 0.015 in. on the thrust side, and the rings are worn the same way. Liner shows normal wear with no scoring.

Recently we put in a new piston and ran for three hours. Then the wrist pin got hot and the piston scored the liner.

Checking the engine we found that outside lubricator supplying oil to the pistons was working right when scoring occurred. We now get a noise from this cylinder that sounds like a piston slap. Since engine is only 11 months old and all pistons are the correct size we're wondering what is causing our trouble.

Why did piston wear oval in such a short time? What's best way to repair piston and liner? How can we avoid this trouble in this engine in the future?—*BB*

Will you help readers who sent us problems? Extra pay for photos or sketches



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Two engineers—working together—are responsible for every industrial piping application that uses Flexitallic Spiral-Wound Gaskets. One is the engineer-in-charge. The other is the Flexitallic Gasket design engineer. Working together, they build a gasket for *your* piping installation . . . to *your* specifications. Each Flexitallic Gasket is engineered to specific conditions of thermal and physical shock, corrosion, or unusual joint stress by spiral-wound V-crimped plies of the required metal with alternating plies of the proper filler. This results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at predetermined load. For all pressure/temperature ranges from vacuum to 4000 lbs., from extreme sub-zero to 2000 F. For all flange series from 150 to 2,500 lbs. For all standard joint assemblies. In four thicknesses for special requirements: .125″, .175″, .250″, .285″. With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

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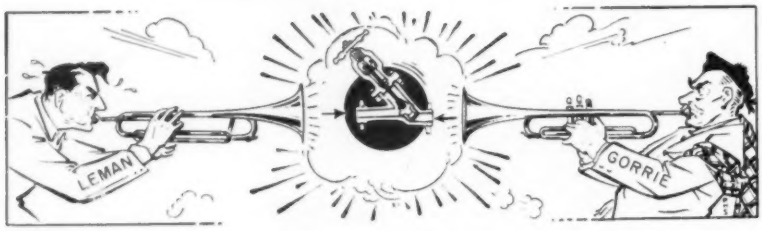
ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers



We're Steamed Up About Steam Flow

I AGREE: Boiler pressure should be over the disk, as W Ryan says (POWER Jan, p 136). Scale or sediment hardening should not be a factor in determining flow direction. If sediment over the disk could get so hard as to keep one valve shut, could boiler pressure dislodge that sediment from under another valve seat, even if second valve could be opened?

Here is an application. Our 900-psig boiler has a dry-type superheater; header drains have valves of this type. Both valves leaked and were carefully reground. Inlet header valve was tight, but outlet valve continued to leak. New seat and disk gave a perfect seat, but valve still leaked. We installed a new valve with the old below it; both leaked. These valves were installed with pressure under the disks; seats were screwed into place with a hex drive.

Valve draining inlet header was subjected to 530 F; valve in outlet header about 670 F. Apparently 670 F was high enough to make valve seat assume a slight hex shape from the difference in metal thickness forming the hex drive. We reversed the valve and it was, and still is, tight.

But we don't approve of drains and stop valves, serving miscellaneous equipment, being installed with pressure over the disk. The gaskets and packings are a potential weakness.

MARVIN LEMAN *Shelton, Wash.*

ALL WRONG: Valve flow suggested by Ryan in Jan isn't OK. In a plant where I worked boiler pressure was against stem of blowdown valves in waterwall headers. In spite of water conditioning, scale and sludge plugged valves, kept them shut. Boiler pressure against the valves corrected this.

Installing a valve with pressure against the stem and gland invites trouble from leaking glands; nothing stinks more than leaking glands. To further disagree with Ryan, these valve stems are made so they should not break.

In one case of waterwall headers being blown down, there was considerable belting and sweating around the blowoff valve. One fellow, who should have known better, joined the scrimmage, used a hammer to pound the valve. Result was only a slight crack and a fine spray. He was lucky!

When we removed the valve, the whole caboodle was plugged with fine sludge from the back seat to the valve, nicely packed around the stem. But inlet from the header had very little hard-packed sludge. That valve was blown down every 8 hr. Every time valve was opened, sludge was gradually locked in and compressed. Apparently boiler-water discharge did not remove sludge.

Hoot, mon! Those settings were all wrong. Your arrows are correct.

J M GORRIE *Richmond, Va.*

No Secrets Here

THIS MAY BE a trade secret. But what are these few secrets between us? I am very eager to know who is the distributors of the book POWER. That is the most powerful I've seen this season, and I would certainly like to get my hands on the author. If your company is the distributor or whoever it might be, please quote the price of each or for the subscription per quarter or year as the case may be and the secret of sending my money order promptly to you.

I am hopeful you will be glad to send us this information with the speed of light and greatly appreciate an answer to this inquiry.

A READER *Philippine Islands*

ED. NOTE: *Our correspondent may have difficulty with the English language, but we are glad to note he had no trouble spotting* POWER *as an outstanding magazine. We extend sincere thanks for this compliment from the Philippines.*

Misnamed Cylinder

MARMADUKE'S DESCRIPTION of the SS *Mongolia Queen* engines (p 142, Jan POWER) has me confused.

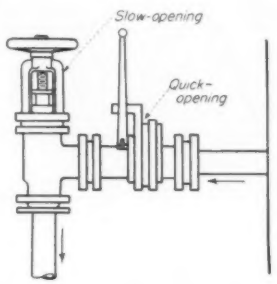
He says she had two 4-legged triple-expansion engines—each engine having a low-pressure cylinder at either end with a high- and low-pressure cylinder in between.

It seems to me he has turned this engine into a 4-legged compound, one high-pressure and three low-pressure cylinders. I have never heard of even one! I think he means two low-pressure cylinders at either end with one high and one intermediate in between.

He should stick to Duggan's Dew!

BILGEWATER RENNIE *Los Angeles, Calif.*

ED. NOTE: *Right you are. Marmy did say two low-pressure cylinders at either end with one high and one intermediate in between. But we left the Bent Propeller with a slight list to starboard and got our notes mixed up.*



Which Valve Should Be Opened First?

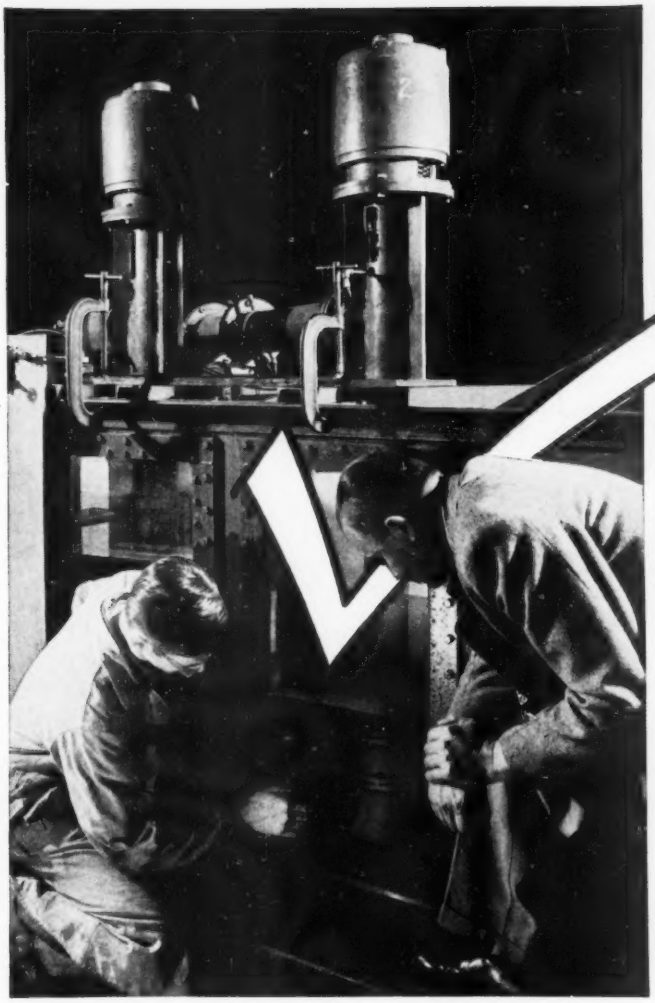
OPERATOR'S NOTEBOOK on Blowoff Valves, p 108, Apr POWER, says, "First open quick-opening valve slowly. Then open slow-opening valve slowly enough to prevent shock, but fast enough so seat won't wiredraw. To stop blowing, close slow-opening quickly, then fast-opening." The advertisement on p 69, Nov POWER, agrees with this principle.

But the book, *Steam Plant Operation*, by Woodruff and Lemmers, McGraw-Hill Book Co, reads (p 213, ch 5, par 7), "The quick-opening valve is opened last and closed first."

Since I have sworn by both POWER and this book, I would certainly appreciate a definite interpretation of boiler blowdown. Which is the right method?

H ORTNER *Moorhead, Minn.*

ED. NOTE: *What do you readers think?*



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Use this Allis-Chalmers pump laboratory to duplicate your suction bay design and operating conditions.

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The Allis-Chalmers pump laboratory is located at the West Allis, Wisconsin, Works and is available for use for all power plant operators and consulting engineers with large pump and water supply problems. For details of the services available, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3973

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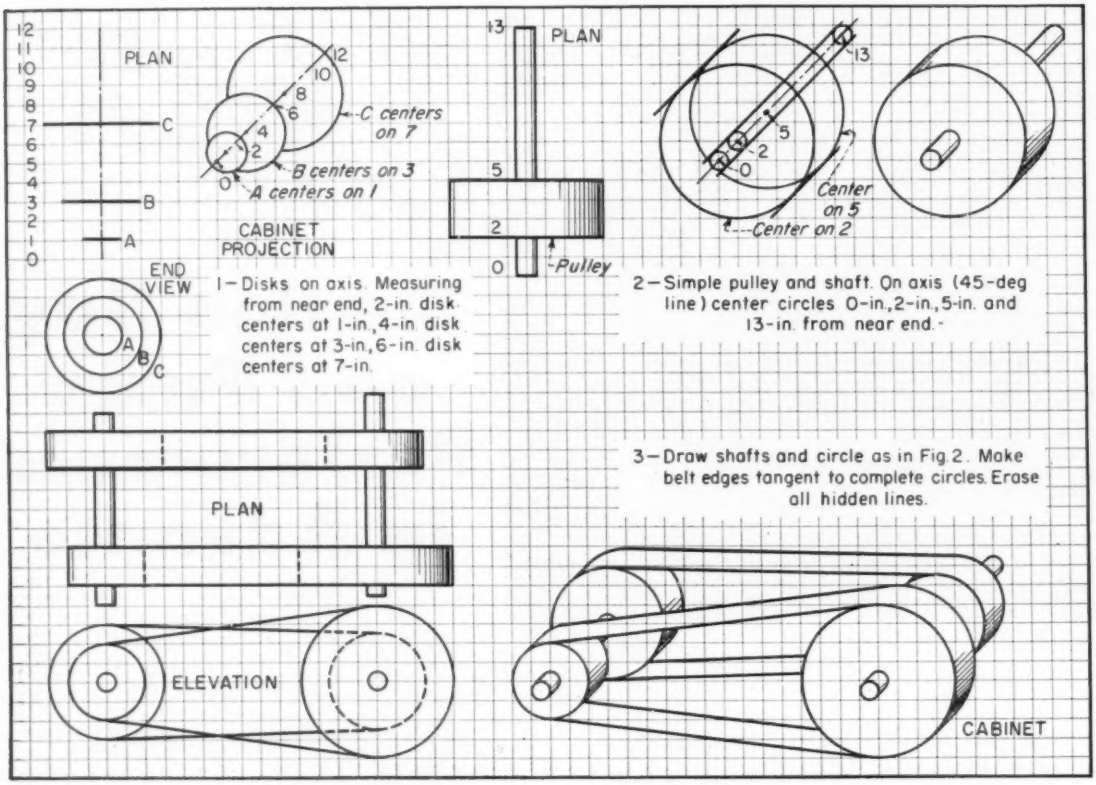
HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH


PLAN
C
B
A
END VIEW
A
B
C
C centers on 7
B centers on 3
A centers on 1
CABINET PROJECTION
1—Disks on axis. Measuring from near end, 2-in. disk centers at 1-in., 4-in. disk centers at 3-in., 6-in. disk centers at 7-in.
PLAN
Pulley
2—Simple pulley and shaft. On axis (45-deg line) center circles 0-in., 2-in., 5-in. and 13-in. from near end.
Center on 5
Center on 2
PLAN
ELEVATION
3—Draw shafts and circle as in Fig. 2. Make belt edges tangent to complete circles. Erase all hidden lines.
CABINET

Easy Sketching System—7

► AT TIMES we have compared this "cabinet" sketching system with isometric where the three main axes are 120 deg apart. Isometric is often preferred for technical illustrations as it has slightly more eye appeal. Yet cabinet has almost as much, and is generally much easier to draw for three reasons:

(1) It can be drawn on ordinary squared paper. (2) Often the front view is just a repeat of an ordinary "elevation" front. (3) If circles face the viewer, they can be drawn with a compass, whereas isometric requires an ellipse template for all circles.

The last is a great timesaver for shop sketches of pullies, shafting, etc. If possible, draw these with shaft end facing you. Then shaft axis line is 45-deg line. All circles center on this axis.

To locate centers lay out scale on axis, taking diagonal of one square equal to two of square units in plan or elevation. Draw circles full scale.

Look at Fig. 1. Three metal disks are strung along an axis (here merely center line). From plan view, measuring from near end of axis, *A* is 2-in. circle centered at 1 in.; *B*, 4-in. circle at 3 in.; *C*, 6-in. circle at 7 in.

Length scale is repeated on diagonal axis line, taking diagonal of one small square as 2 in. Draw nearest circle first, then work back, so you won't have to erase hidden parts.

Fig. 2 shows practical use. Working from near end of axis at center *O*, draw 1-in. circle; at center 2, draw 2-in., 8-in. circles; at center 5, draw 8-in. circle; at center 13, draw 2-in. circle. Draw common tangents to big circles to complete pulley rim. Small circles locate shaft.

To get final sketch at right erase hidden lines, shade a little.

In Fig. 3, draw both shafts with their pullies in the same way. At first, draw all eight pulley circles complete, but lightly. Draw belt edges tangent to these circles. Erase hidden lines. Make rest heavy. Shade sketch to suit your taste.

LOOKING DOWN YOUR PIPELINE...

. . . what do you see? Dependability . . . or frequent failure; long, economical life . . . or costly maintenance; W-S FORGED STEEL FITTINGS . . . or the ordinary kind that are a source of constant trouble and expense?

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MARMADUKE yanked the gun from Indian Moose's hands, yelling, "I'll stop this argument before someone's hurt."

The Plugged Stack

► AFTER WADING THROUGH welding literature and visiting maintenance shops to run a few hard-facing beads ourselves, one morning we finally said, "To hell with welding." Then we headed for Bedlam's Bent Propeller Bar. This habit of blowing our safeties comes from our seafaring days, when we worked around the clock overhauling boilers down in Rio, then headed ashore with our fireroom gang for a well-earned steak dinner at El Toro Grande. We ended up by sashaying the girlies around the dance floor at Cafe La Vista until close to sailing time next evening.

The Bent Propeller in New York is a far cry from those South American hot spots we visited each trip, but it, too, is rewarding. For one thing, where else can you stand, sit or lie (as the case might be) at the feet of that master power engineer, Marmaduke Surfaceblow?

Marmy was docked at his usual berth, all 6 ft 4 inches of him, holding up his end of the bar. The loud guffaws, clanking glasses and general confusion seemed not to disturb our hero's silent reverie. With his old gray bowler shoved down toward the bow of his massive white dome, he just stared at the bottle of Sandpaper Gin before him.

"You guys might of operated power plants," a character near Marmy was saying, "but I've done some fancy slide-rule engineering in my day."

"BILGEWATER ON BOOK ENGINEERS WHO NEVER GET THEIR HANDS DIRTY," roared Marmaduke, suddenly coming to life. "I'll tell you about unplugging a plugged stack that had all the theory engineers at sea."

That did it. The cash customers shut their traps and settled down, for the old master was about to sound off.

"Back in 1939 I landed at the Barens River's mining camp in the wilderness of northern Ontario," bellowed Marmaduke in his foghorn voice. "We were going to sink a shaft in what finally turned out to be a rich deposit of 'hard rock,' with a high nickel content.

"The place was so far from nowhere that everything from machinery to food supplies was flown in. And transportation alone for spuds cost $18 a bushel. There already were three bunk houses, a commissary, a mess hall and a power-plant building when I arrived. But the machinery was scattered all over the hillside. My job was to set it up and get up steam.

"I had a handful of men to help me install two 90-hp boilers, one steam-driven air compressor, a small electric generator, pumps and a steam hoist for the mine cage. We put up the 60-ft steel stack with a large screen around its top to keep sparks from burning the surrounding brush. That screen was about four feet high.

"There was a large clapper on the screen to shake soot loose so the stack wouldn't plug up. The clapper was worked by a long chain running down the stack.

"The boilers were hand-fired with cordwood from the nearby brush, and used natural draft. Steam pressure was controlled by opening up or closing in the stack dampers and ashpit doors.

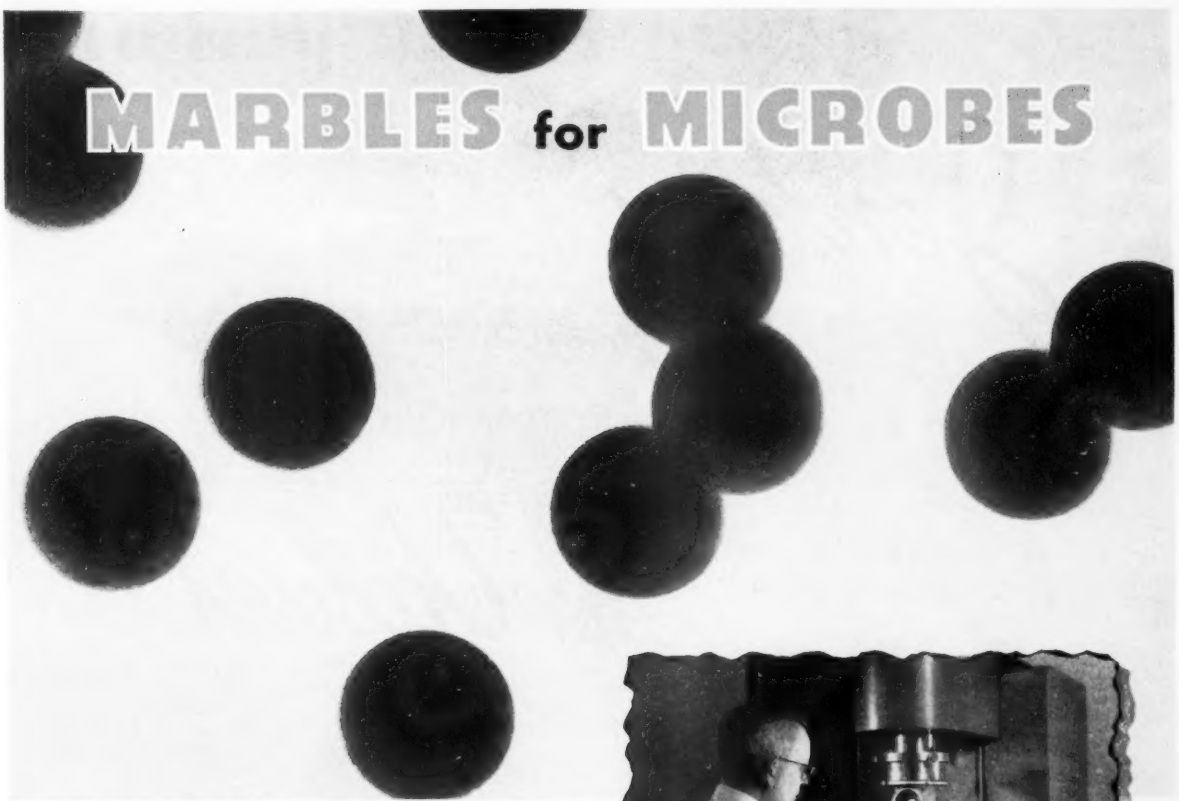
"I had all the equipment set up, and lit off the boilers a month after landing. With steam up, the camp really began to hum. And by the time the shaft was sunk, the plant was running around the clock, seven days a week.

"After all that work the mine superintendent told me to take a blow for a week down to Toronto. Said he had a lot of new help coming in. He wanted me to take a good rest so nothing fouled up after I got back because the mine had to produce from the word go.

"I packed my bag and left on the next plane. In Toronto I caught up with civilization, bought supplies, and for good measure checked up on ship-

(*Continued on page* 204)

MARBLES for MICROBES



Above—100,000X enlargement of latex spheres used to calibrate electron microscope in Nalco Laboratories. Actual diameter of spheres is 0.25 microns—.00000975 inches! *Right*—Inserting specimen holder in vacuum chamber of Nalco electron microscope.

. . . How they assist research toward better Water Treatment

PERHAPS even too small to make good marbles for microbes, these tiny spheres help Nalco Scientists in their investigations of the microscopic realms of matter only recently made visible to the human eye by the electron microscope.

Use of the electron microscope in water treatment research is significant because it typifies the continuing efforts of the entire Nalco organization to keep the Nalco System representative of the first and best in all phases of modern industrial water treatment.

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Nalco WATER TECHS

New reprint of A.S.M.E. Paper No. 52-A-30: *Experimental Studies of Boiler Tube Metal Temperatures: Effect of Heat Transfer Rate and Deposit Thickness*, gives technical data on high-heat-transfer-rate effects (140,000 to 300,000 Btu/sq. ft./hr.) at pressures from 250 to 2500 p.s.i. 16 pages, with tables and diagrams. Author: C. Jacklin, Director, Engineering Research, National Aluminate Corporation.

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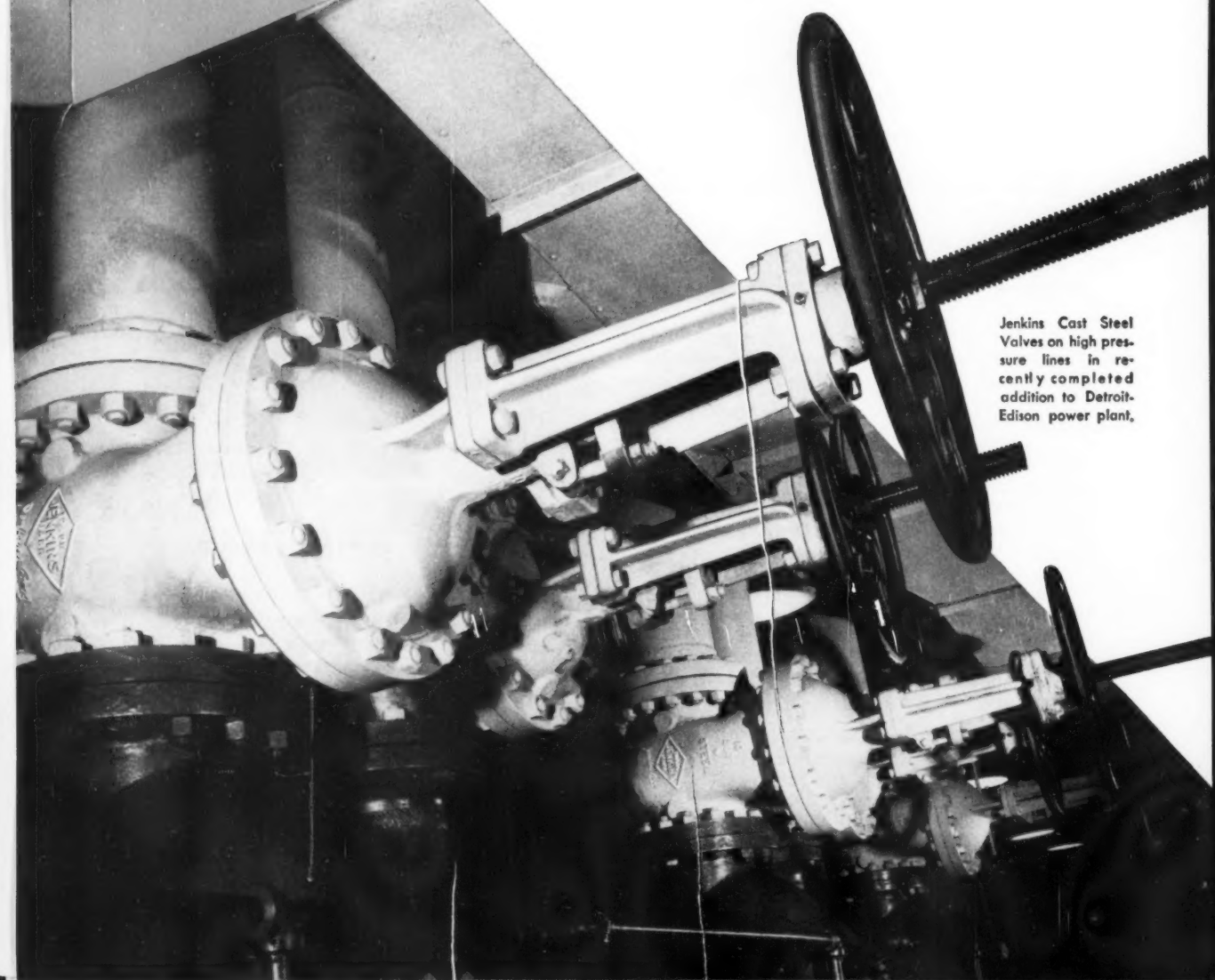

Jenkins Cast Steel Valves on high pressure lines in recently completed addition to Detroit-Edison power plant.

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. . . for dependable economy in higher pressure— higher temperature services

Mounting pressures and temperatures in power generation and industrial processing call for Cast Steel Valves. For this increasing need, Jenkins offers a wide selection of patterns that have met the test of the toughest services throughout industry.

In these valves, Jenkins provides a wide margin of strength and safety beyond ratings. Special refinements in design extend their service life, assure long, trouble-free performance. Resulting top efficiency and low maintenance records measure up to the high standards established for all valves developed by Jenkins Valve *specialists*.

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DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Price control is finished, even on a standby basis. All ceilings will be gone by April 30. Wage control is out, too, so wage increases are in the cards. Wage Stabilization Board, now disbanding, has backlog of 10,000 increases pending. And unions are sure to make demands based on price rises

Many prices will rise, and soon, but only where the natural supply-and-demand level was pushing against the control ceiling. Raw materials slated to rise probably include copper, aluminum, steel, crude oil and cement. Defense costs, too, will rise, as a direct result of rises in raw materials and components.

Material and product control is going also. Present authority expires June 30. Eisenhower plans only a military priority to replace the Controlled Materials Plan.

New construction records are likely for 1953, but construction employment for the year may be slightly down. Total employment may hit 63,000,000 this summer, Labor Dept. says. Except for steel strike, employment would have risen that high last summer.

Russia's arms often look junky, but may be most practical considering USSR production limitations, mainly shortage of skilled labor. Captured tanks reveal crude workmanship (that is, ragged welding) at noncritical points. Adequate quality at key points suggests that skilled workers are reserved for essential work only.

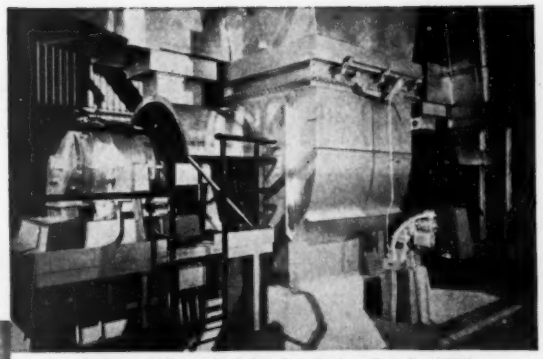
Lead and zinc prices have dropped about 30% in six months. That has pinched back mine output in this country, but supplies from abroad are plentiful.

Zirconium steps out as a commercial metal. To meet demands of Atomic Energy Commission Carborundum Metals Company will build and run zirconium plant in Akron, Ohio. Annual output of 150,000 lb will go to AEC for less than $15 per pound. Metal has high resistance to corrosion by acids and alkalis, but big advantage for AEC purposes is low absorption of precious neutrons when used as structural material in reactors.

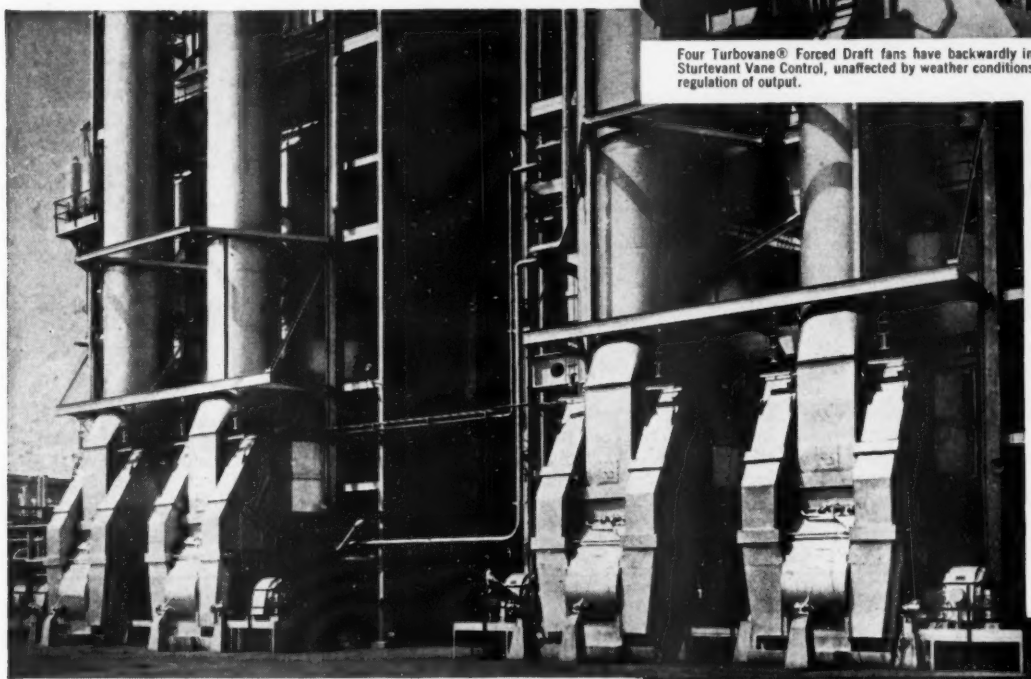
Law to free atomic power is now urged by many, including Detroit Edison Company. Present Atomic Energy Act (McMahon Act of 1945) forbids private companies to own or build nuclear reactors – also restricts ownership of fissionable materials. Unlike other utility proposals, which could see no present possibility of commercial atomic power without Government subsidy or guaranteed purchase of plutonium, Detroit Edison, teamed with Dow Chemical Company, asks for no subsidy, thinks atomic power can soon stand on own feet.

Detroit Edison's atomic plant would be built in metropolitan Detroit area and feed power into existing electric lines. First studies are now complete. Company expects to finish specific designs this year and can then start building if U. S. says OK.

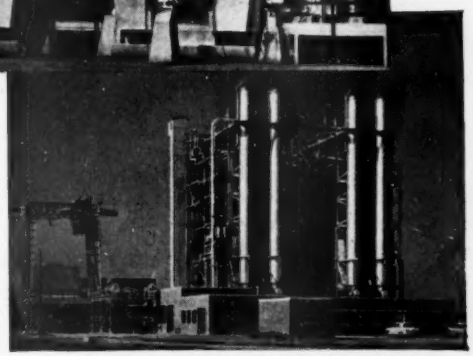
Sturtevant Fans Engineered for OUTDOOR INSTALLATIONS



Four Turbovane® Forced Draft fans have backwardly inclined blades. Sturtevant Vane Control, unaffected by weather conditions, gives instant regulation of output.



Sturtevant Fans are exposed to the elements the year 'round. The four Induced Draft fans are of the Multivane® type with forwardly curved blades. Control is by intake dampers.



Only structural steel framework surrounds the boilers and stacks at Arkansas Power and Light's new Hamilton Moses Station, Forrest City, Arkansas. Elimination of enclosures brings substantial savings in construction costs, an economy that helps this company hold the line against higher rates.

Outdoor service has put new demands on mechanical draft apparatus—protection from temperature extremes, dust, salt-air corrosion, rusting from rain or snow. Smooth, dependable operation of bearings and mechanisms must be maintained regardless of exposure to the elements.

In the new Hamilton Moses Station, Arkansas Power and Light's eight Sturtevant fans will perform under all kinds of weather. These fans are expertly engineered and sturdily built of heavy steel plate and welded construction. They have sealed-in bearings that protect against atmospheric changes. On the forced draft fans, for example, Vane Control® has a simple link and lever action which allows easy operation in all kinds of weather, requiring no interior lubrication.

Whatever conditions your mechanical draft equipment must meet, there's a Sturtevant fan to satisfy the requirements. For over 90 years, Sturtevant has meant satisfaction in mechanical draft. Get complete information from your local Westinghouse-Sturtevant office, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

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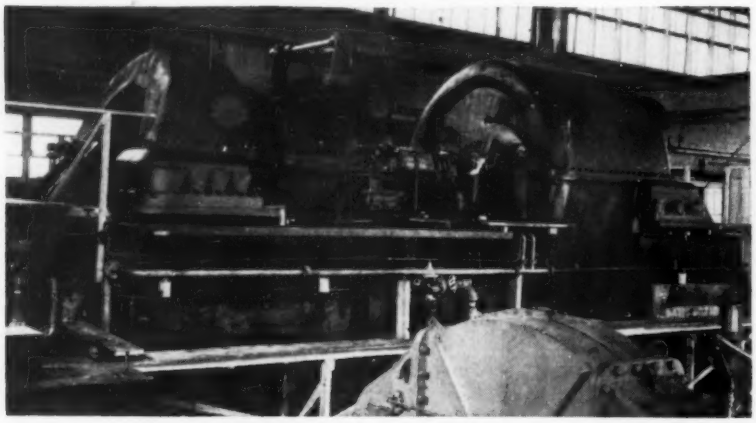
NEW FREE BULLETINS 163



Giant Blower Has Steam Turbine Drive

This giant blast furnace turbo-blower, built by De Laval for Armco Steel Corp, is driven by a 15,220 hp, 2500 rpm, 16-stage steam turbine. Steam conditions are 400 psi and 750 F. Blower is a 5-stage unit rated 121,000 cfm at 35 psig discharge pressure. Total weight of turbine and blower is over 167 tons. Shafts of each were made large and heavy to meet expected wide range of speed conditions.

Coming Events

March 24-27—Second Annual American Power Conference, Sherman Hotel, Chicago, Ill. R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

March 24-27—National Power Show and annual meeting National Assn of Power Engineers held in conjunction with American Power Conference, Sherman Hotel, Chicago, Ill. A F Thompson, sec, 176 W Adams St, Chicago, Ill.

April 13-15—American Society of Lubrication Engineers, annual meeting, Hotel Statler, Boston, Mass. W P Youngclaus, Jr, ASLE, 343 S Dearborn St, Chicago 4, Ill.

April 28-30—American Society of Mechanical Engrs, spring meeting, Drescher-Warrick Hotel, Columbus, Ohio. O B Schier, mgr, ASME, 29 W 39th St, New York 18, N.Y.

American Power Conference Plans Second Meeting

Second annual meeting of the American Power Conference will be held March 25, 26 and 27, 1953 at the Sherman Hotel in Chicago, Ill. This conference, successor to the Midwest Power Conference, enjoys the sponsorship of the Illinois Institute of Technology with nine other cooperating universities throughout the midwest and ten local and national engineering societies. A highlight of last year's conference, which drew 2500 registrants, and a feature of the 1953 meeting will be the annual power show put on by the National Assn of Power Engineers.

Thirty six separate sessions, luncheons and dinners are scheduled for the three-day conference period. High in interest value to the power industry are major symposiums on Industrial Water Problems, under the chairmanship of P W Swain, Power editor and involving Power's editorial staff; Industrial Use of Atomic Energy, with L C McCabe, chief, fuels and explosives div, Bureau of Mines as chairman; Niagara Power Developments under J G Tarboux, professor of electrical engineering at Univ of Michigan as chairman; Industrial and Institutional Plant Operation with G R Carpenter, plant engineer, Minneapolis Moline Co acting as chairman.

Detroit Edison Promises Workable Atomic Power Design

Detroit Edison Co, teamed with Dow Chemical, has been studying atomic power problems as one of five groups selected by the Atomic Energy Commission to carry out this phase of nuclear energy development. The other teams are Monsanto Chemical and Union Electric Co of St. Louis, Commonwealth Edison and Public Service Co of Northern Illinois; Pacific Gas and Electric Co and Bechtel Corp; Pioneer Service & Engineering Co and Foster Wheeler.

Arthur S. Griswold, assistant to Edison's president Walker L Cisler, has announced that their team has completed its first studies. On the strength of them they feel that conditions are right for the next step, an actual design. This optimistic report is the first to indicate any readiness to undertake the construction phase.

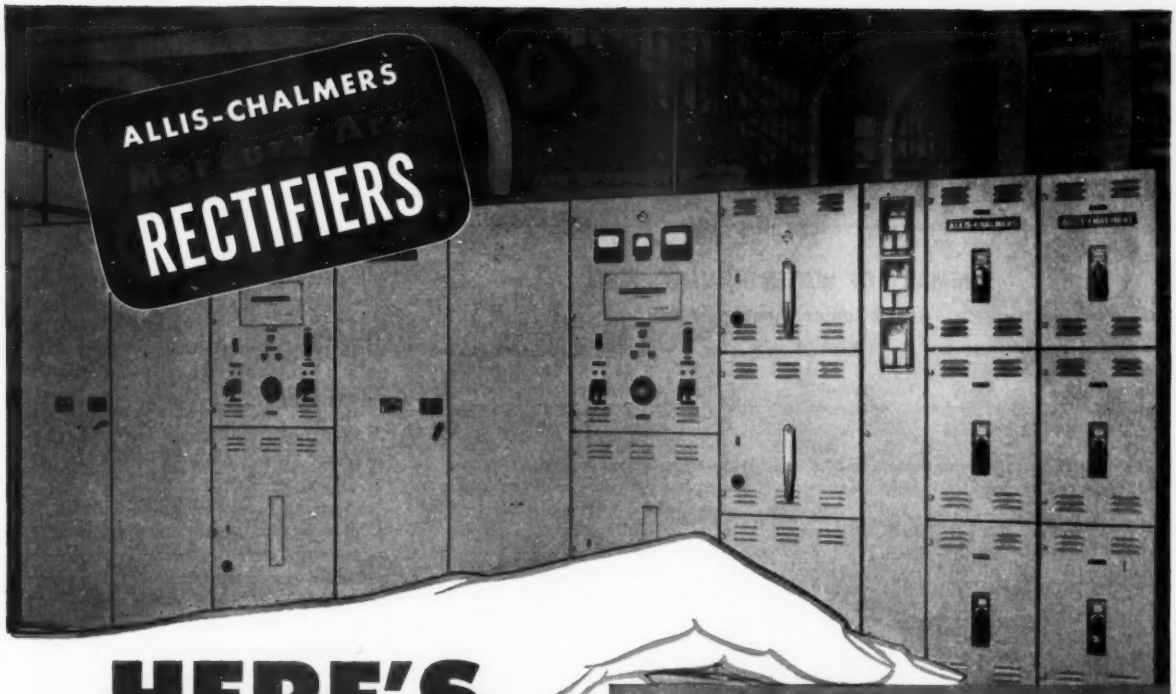
The Atomic Energy or McMahon Act of 1946 expressly forbids private construction or ownership of a nuclear reactor. But there are those who look for Congress to relax some of these controls this year and Detroit Edison hopes to get permission to build such a plant.

At the moment the plant will probably follow these lines. A nuclear reactor will produce the steam which will then be used to run a conventional turbine. This arrangement is held to be the only practical approach at this date. The technical problems surrounding direct conversion of nuclear energy to electric have not been solved.

Wanted... More Engineers

Our engineering shortage is serious. Right now industry and civilian-government activities need between 35,000 and 45,000 more engineers, with addi-

(*Continued on page* 190)

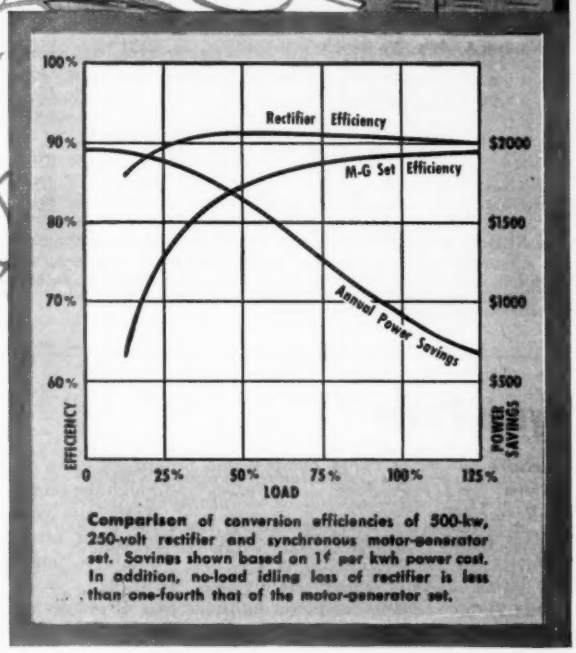


HERE'S PROOF of Low-Loss Conversion

TO OBTAIN economical dc power for arc furnace and blooming mill auxiliaries, West Virginia Steel & Manufacturing Company recently installed mercury arc rectifiers.

The factory-packaged Allis-Chalmers unit includes duplicate 500-kw, 250-volt rectifiers, with tube, breaker, control, and metering compartments, plus dc and ac plant feeder breakers. Since transformers could be installed outdoors, the assembly departs from the usual double-ended arrangement.

Rectifiers were chosen for their high conversion efficiencies *plus* simplified foundation needs, easy installation and minimum maintenance. And Allis-Chalmers units incorporate continuous excitation, grid phase control, internal cooling and enameled anode seals.



Comparison of conversion efficiencies of 500-kw, 250-volt rectifier and synchronous motor-generator set. Savings shown based on 1¢ per kwh power cost. In addition, no-load idling loss of rectifier is less than one-fourth that of the motor-generator set.

Use A-C's Engineering Experience

By calling your A-C representative, you can put A-C's quarter century of rectifier application experience to work on your power conversion problems. Allis-Chalmers, Milwaukee 1, Wisconsin. A-3989

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

TECHNICAL BRIEFS

Latest engineering developments for busy power men

12 Digests for you on:

HYDRO POWER
COAL GASIFICATION
FUELS AND FIRING

SUMMARY OF WATER HAMMER TESTS

Grand Coulee Pumping Plant

Units in operation	Units tripped	Type of shutdown*	Pump lift, ft	Maximum head at pump, ft	Minimum head at pump, ft	Maximum reverse pump speed, rpm
No. 1	No. 1	A	280	390	277	240

For a type A shutdown the maximum computed head at the pump was 392 ft.
For a type A shutdown the maximum computed reverse speed of the pump was 244 rpm.

Granby Pumping Plant

No. 1	No. 1	A	131	217	126	0
No. 2	No. 2	A	131	214	124	0
No. 3	No. 3	A	131	226	126	0
No. 1, 2	No. 1, 2	A	131	203	103	0
No. 1, 2, 3	No. 1, 2, 3	A	131	214	87	0
No. 2	No. 2	B	131	214	122	415
No. 3	No. 3	C	131	203	126	219
No. 2, 3	No. 2, 3	C	131	265	99	180
No. 1, 2, 3	No. 1, 2, 3	C	131	272	99	167

For a type A shutdown the maximum computed head at the butterfly valve was 210 ft.
For a type A shutdown the maximum computed reverse speed of the pump was zero.

Tracy Pumping Plant

No. 4	No. 4	A	203	230	62	210
No. 3, 4	No. 3, 4	T	203	228	35	200
No. 3, 4	No. 4	A	203	226	87	210

For a type A shutdown the maximum computed head at the butterfly valve was 230 ft.
For a type A shutdown the maximum computed reverse speed of the pump was 200 rpm.
*Type of shutdown: A, simulated power failure at pump motor; B, butterfly valve held open after simulated power failure at pump motor; C, closing cycle of butterfly valve delayed 9 sec after simulated power failure at pump motor.

Hydro Power

Pressure Surges at Large Pump Installations. *By J Parmakian, U.S. Bureau of Reclamation.*

This paper covers methods of waterhammer analysis and control as used in the design of Grand Coulee, Granby and Tracy pumping plants for power failure at the pump motors. The Grand Coulee pumps, rated 1350 cfs under a 310 ft head, are driven by 65,000-hp synchronous motors at 200 rpm. Each pump discharges into a 12-ft discharge line 700 to 940 ft long with a siphon outlet. When power fails to a motor, water in the discharge line flows back through the pump and reverses its rotation until line is drained, down to intake level.

Granby pumps are rated 204 cfs under a 186-ft head and are driven by 6000-hp synchronous motors at 327 rpm. The three pumps connect into a 11-ft discharge line 3650 ft long with a siphon outlet. If power fails to a motor a butterfly valve closes to stop back flow through the pump.

Tracy pumps, rated 767 cfs against a 197-ft head, use 22,500 hp 180 rpm synchronous motors. Each pump has a butterfly valve in its discharge and each pair of pumps connect into a 15 ft discharge line with a syphon outlet. If power fails to a motor the butterfly valve closes to stop back flow.

Pressure surge tests were conducted on the three pumping plants to check the pumps, discharge lines and pressure control for power failure at the motors. A summary of the observed and computed waterhammer effects at the three pumping plants are given in table above from which it is seen that there is close agreement. For example, for a type A shutdown (a power failure at the pump) in Grand Coulee plant, the maximum computed head at the pump was 392 ft compared to 390 on test. Maximum calculated reverse speed of the pump was 244 rpm against 240 rpm on test. Similar results were obtained at the other plants, on simulated power failures at the pump motors. *ASME paper No. 52-A-60.*

Combatting Frazil Ice in Hydro-Electric Stations. *By K J Granbois, Safe Harbor Water Power Corp.*

This paper reports on a method of precise water temperature measurements with an electric resistance thermometer and recorder and its application as a frazil ice warning system for hydro-electric stations.

The fine needle-like ice that is often distributed throughout a volume of moving water or is formed in water cooled below the normal freezing point (32 F or O C) is called "frazil ice". It is the cause of considerable trouble in the operation of hydro power stations, water works, and other power stations that depend on an uninterrupted water supply. When reliable warning of the impending ice formation can be obtained, adequate steps may, in some instances, be taken to minimize its effect on station capacity. A graphic record of water temperature has been found a reliable means of predicting the formation.

When the possibility of ice is indicated on the temperature recorder, the first operation is to remove the trash screens from the top half of the intake area. Also, at Safe Harbor, facilities are available for passing steam through the hollow stay vanes of the turbine distributor ring. Continuous motion of the wicket gates minimizes ice forming on the gates; however, if the run is severe, this procedure is not adequate.

The reduction in generating capacity is a means for measuring the degree of ice accumulation on the wicket gates and distributor ring, when a 50% load reduction is indicated and the wicket gates are still movable, the gates are closed and the machine is motored. Agitation and heat generated from the additional hydraulic losses removes the ice. If the above measures prove futile the unit is shut down, head gates lowered, intake drained, and steam is admitted to the turbine and intakes to melt the ice.

Electrically heated trash screens are used on a small hydraulic turbine driven

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

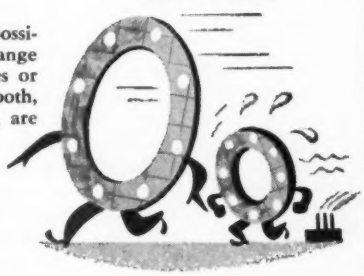
The right type of gasket -properly installed -saves many a costly sealing headache...

Be sure I'm in style.

It's hardly worth while to use inferior quality gasketing for a replacement job, when the right style of a *good* quality gasket material can generally be easily and inexpensively obtained from your near-by Packing Distributor. Therefore, for a packing that will give good service, be sure the style selected is the one recommended for your conditions.

I work better when I'm thin.

Use as thin a gasket as possible for the particular flange condition. When flanges or surfaces are flat and smooth, thin gaskets, as a rule, are better than thicker gaskets. Where surfaces are rough and do not line up perfectly, thicker gaskets usually do a better job.



Don't use oil on me!

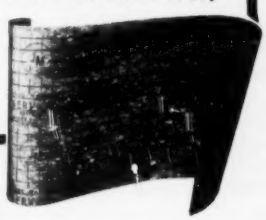
Often gasket materials have rubber in their composition, and oil causes deterioration of rubber. If it is desirable to graphite one or both surfaces of the gasket for easy removal, use a solution of graphite and water, with or without a small amount of glycerine. If the joint is to be permanent, it is better not to treat the gasket at all.

I give better service if you follow these rules, too.

1. Ring-cut gaskets are preferable to full-face gaskets. 2. See that the gasket is properly centered and does not project inside the flanges. 3. Make sure flanges are perfectly clean and true. 4. See that flange surfaces line up and are parallel. 5. Follow up bolts the next day after installing new gaskets.

Why you'll get a better sealing job from J-M SERVICE® SHEET GASKET
Style No. 60

Service Sheet owes its superior performance ability to the care used in its manufacture to produce a consistently uniform product. It is made of selected long fiber asbestos and special heat-resisting compounds, bonded together under heat and pressure. The result is a tough, durable sheet without plies or laminations. It is unusually pliable and resilient and does not dry out in storage. It is effective against superheated steam, air, gas, water, hot oil, ammonia, and many acids and other chemicals.



Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 60, New York 16, N.Y.

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Johns-Manville PACKINGS & GASKETS

More TECHNICAL BRIEFS

Begins on page 150

exciter in the Holtwood station. The total power required is 50 kw.; or 1.75 watts per square inch of screen bar area; of 7.5% of the power generated by the unit; or the equivalent of a 4% reduction in a total head of 60 feet. The heating is applied only when the temperature records indicate a possible ice run. The velocity at intake entrance is 2.0 ft./sec. *AIEE Paper No. 53-8.*

Coal Gasification

Pulverized Coal Combustion in a Water-Cooled Radiant Tube. *By R A Sherman, G E Keinath, Battelle Memorial Institute; R T Sawyer, American Locomotive Co.*

Steam generators fired with pulverized coal are now designed for rates of heat liberation of the order of 20,000 Btu per hour per cubic foot of furnace volume or less. On the assumption of a 20 per cent excess air, of an average gas temperature in the furnace of 2500 F, and of a uniform gas flow over the entire cross-section of the furnace, the residence time of a particle in the furnace would be 2½ seconds. Because the gas does not flow uniformly through the entire cross-section, the velocity of travel is higher and the residence time is less than would be calculated. Inasmuch, however, as the residence time required for 98 per cent completeness of combustion of most high-volatile bituminous coals in the order of one-quarter of a second, it is obvious that large combustion chambers are not necessary to insure economically complete combustion.

The large volume, practically always surrounded by heat-absorbing surface, is provided to insure that the ash is cooled to a temperature low enough to avoid slagging and fouling of the boiler tubes. Such designs are highly satisfactory from the viewpoints both of efficiency of combustion and freedom from excessive slagging, particularly for large steam generators where space is not a particular premium.

Where, however, space is at a premium as, for example, on a locomotive, pulverized coal has not been successfully applied. All attempts of the early 1920's to apply pulverized coal to the steam locomotive encountered difficulty because of slagged ash in the firebox and on the flue sheet of the boiler.

Some years ago, under the sponsorship of Bituminous Coal Research, Inc, it was demonstrated that pulverized coal could be successfully burned without difficulty from slagging of ash at heat release rates of 400,000 Btu per cubic foot per hour. This was accomplished by firing the coal into a long tube of small diameter, which provided a large area of heat-absorbing surface per unit volume. The tubes used were alloy steel of 5-inch diameter and 10-foot length. The tubes, heated to 1700 F, were the heating elements in an experimental metallurgical annealing furnace. Such tubes, fired with natural gas or oil, are widely used for the heat-treatment of metals where it is important that the combustion products must not come into contact with the work. So it was a natural step to try it on coal.

This paper describes a series of combustion trials of pulverized coal in alloy-steel tubes from which the heat was absorbed by an outer, annularly spaced, water-cooled tube. Only one diameter of alloy tube, 5 in., in lengths of 10, 15 and 20 ft, was used for the trials. A highly volatile coal, pulverized to a fineness of 90 per cent through a 200 mesh screen, was fired into this tube at rates of 40 to 160 lb. per hr.

For the arrangement used, the fraction of the coal heat input absorbed by the water in the outer tube was only 20 to 40 per cent. Thus the particular arrangement used was not practical for a boiler. The interest in the tests lies in the fact that a coal whose ash softening and fluid temperatures were 2160 and 2220 F respectively, was burned at extremely high heat liberation rates without difficulty from slagging.

It appears possible that a tube of somewhat larger diameter would give a wall temperature high enough to have a satisfactorily low loss in unburned carbon yet not so high as to result in difficulty from slag formation. The possibility of application of this principal to the steam locomotive boiler prompted the research described. A design of a locomotive incorporating these tubes is presented in the paper. *ASME Paper No. 52-A-123.*

Pulverized-Coal Gasification. *By Kurt Traenckner, Ruhrgas Aktiengesellschaft.*

After briefly reviewing the situation of Germany's gas demand and supply, which makes it highly desirable to set free larger amounts of coke-oven gas by firing coke ovens with producer gas, the general program of research and development of the Ruhrgas A.-G. is explained.

Main efforts were directed towards the development of two gas producers using low-grade pulverized coal or coal dust obtained from the coal-cleaning operations. The first process, involving gasification of pulverized coal in a vortex-type system, with slagged ash removal, has reached the state of commercial applicability, and the results obtained exceed those of conventional gas producers gasifying coke.

The second process described in some detail, the coal dust pulse-jet gasifier, is in the experimental stage but already has shown promising results. Further work is in progress to improve operations and efficiencies.

So far only producer-gas tests using air blast have been mentioned. However, the same principles can be used in making synthesis gas or water gas by operating with oxygen-steam blast, and the results would be expected to be better because of the increase in concentration of the reactants. Tests with oxygen-steam blast are scheduled as soon as the producer-gas program approaches completion. Other processes are also under consideration at Ruhrgas and some are in or past the pilot-plant stage, including the high-pressure gasification of bituminous coal.

The problem of producing gaseous fuels and synthesis gas for a number of important industrial products such as ammonia, liquid fuel, rubber, chemicals, etc, using coal as a basic material, is of great interest throughout the world. Not only do many countries have adequate supply of this raw material, the deposits are mostly of such a magnitude that sufficient supply is ensured after other sources may be greatly depleted. *ASME Paper No. 52-A-102.*

(*Continued on page* 222)

TO OBTAIN COMPLETE TEXT

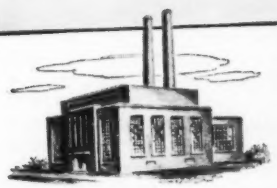
Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source not POWER.

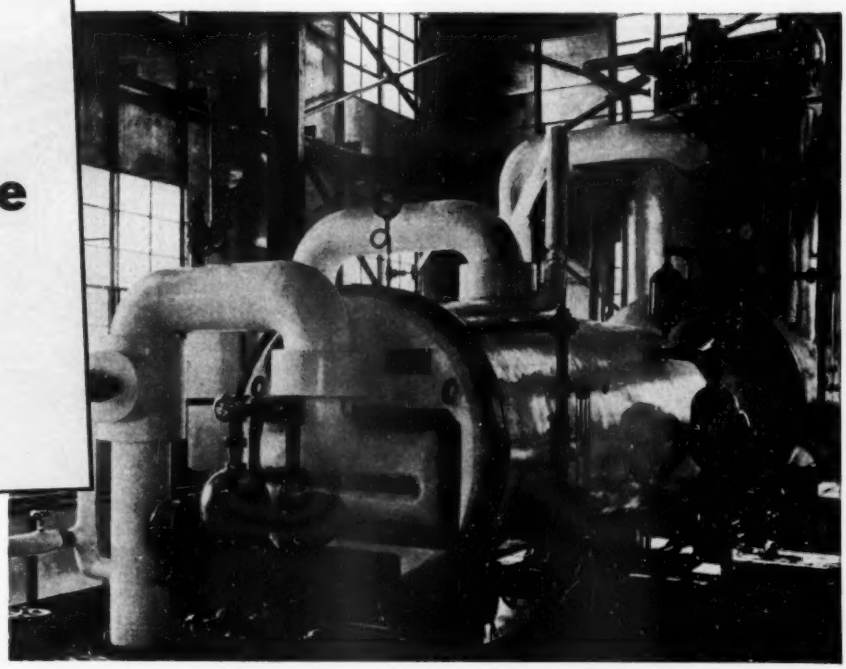
American Society of Mechanical Engineers, annual meeting, Statler Hotel, New York, N. Y. Nov 30-Dec 5, 1952. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York, N. Y. Jan 19-23, 1953. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, N. Y.

Important!

if you have a moderate size boiler plant





Evaporators for eliminating the impurities from boiler feed make-up were originally developed for large power generating stations.

However, the results obtained with G-R Type R Horizontal and Type H Vertical Bentube Evaporators in industrial plants all over the country have proved that *moderate size plants* can also frequently profit by the many benefits of distilling the raw water supply.

This is a possibility well worth your investigation. Boiler feed purification by G-R Evaporators does not involve the use of chemicals nor require periodical water tests or manipulation by skilled operators. Moreover, it is the simplest method of eliminating raw water impurities.

Write for complete information.

THE GRISCOM-RUSSELL CO.
MASSILLON, OHIO

G-R Type R and Type H Evaporators are adaptations of the larger Type J-2 Bentube Evaporator—widely used by central power generating stations. They embody the exclusive scale-shedding G-R Bentube heating elements, and have many additional distinctive G-R features that assure ample capacity, pure dry vapor, long service, low maintenance expense and convenient attendance.

GR302

G-R HEAT TRANSFER APPARATUS **Bentube Evaporators**

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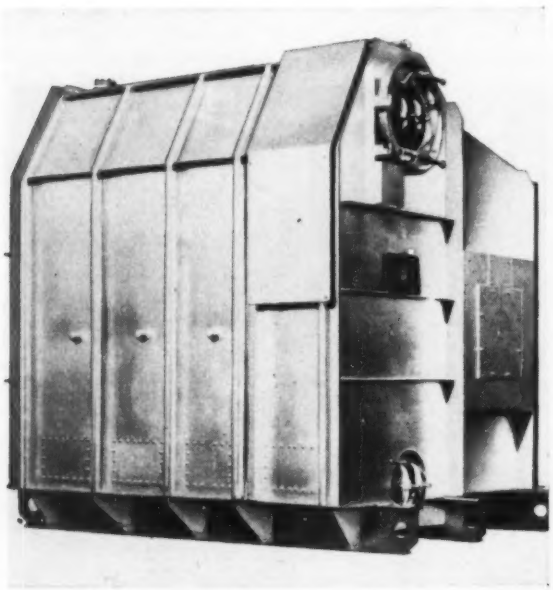

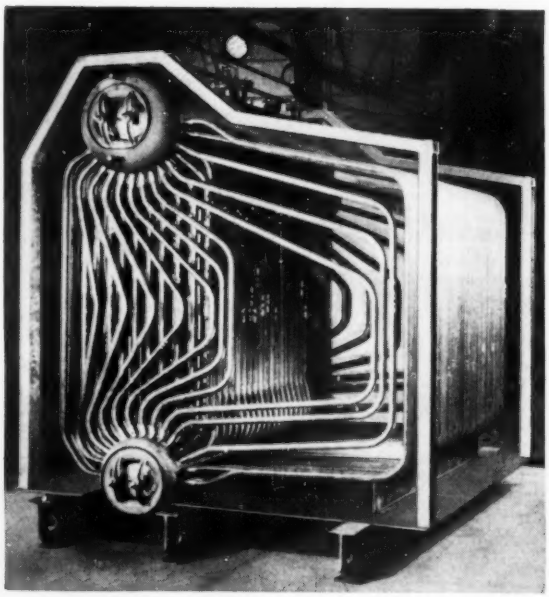

Package-Type, Water-Tube Boilers Have Capacities to 30,000 lb per hr

339 • New standard line of package type water-tube boilers is designed to meet present day requirements for steam and high-temperature hot water. Capacities range from 7500 to 30,000 lbs of steam per hour (or equivalent water ratings) and in design pressures are 200, 300, 600 and 900 psig. All are 2-drum, bent-tube design featuring a water-cooled furnace with tangent water tubes completely shielding the full-length combustion chamber. Large water capacity allows for heavy peak and fluctuating loads. Provision for superheat up to 200 F is available as auxiliary equipment.

Firing is by oil or gas or combination burners. Units are offered with or without complete burner and control assembly.

The gas-tight insulated steel jacket is suitable for outdoor or indoor installation. Normally, units are shipped assembled ready for use after making service connections. However, when necessitated by limited wall openings, sectional casing and standardized sectional parts permit field assembly with minimum amount of field labor.

Completely assembled units can be moved from one location to another. Rigid steel frame base needs no special foundation.

Where boilers are used as first-stage forced-circulation units for high-pressure high-temperature water systems, boiler drums provide natural circulation through the furnace heat-absorbing tubes in case circulatory pumps fail.

Springfield Boiler Co, 1953 E Capitol Ave, Springfield, Ill.

Dc Power Supply

312 • Model 700 high voltage supply is continuously variable from 0-350-v and delivers from 0-750 milliamps. From 30-350 v the output voltage variation is less than ½% for both line fluctuations from 105 -125 v and load variation from minimum to maximum current. The ripple voltage is less than 10 millivolts peak to peak. Cabinet height 22¾ in., width 21¾, depth 15¼.

Kepco Laboratories, 131-38 Sanford Ave, Flushing, N. Y.

Non-Slip Handwheel

348 • Patented non-slip handwheel for valves features four finger-spaced lugs, all continuations of the spoke structure, projecting from the stem hub through an octagonal frame. Design permits a firm, comfortable grip on the handwheel even with wet or greasy hands. Shape eliminates possibility of burned hands from contact with valve stem.

Manufacturer claims the design provides ease of operation in closing valves tight, safety, longer service life and greater overall valve efficiency.

Lunkenheimer Co, Cincinnati 14, Ohio.

(*Continued on page* 156)

For more data on these items, use post cards p 163. Identify your request with item number.

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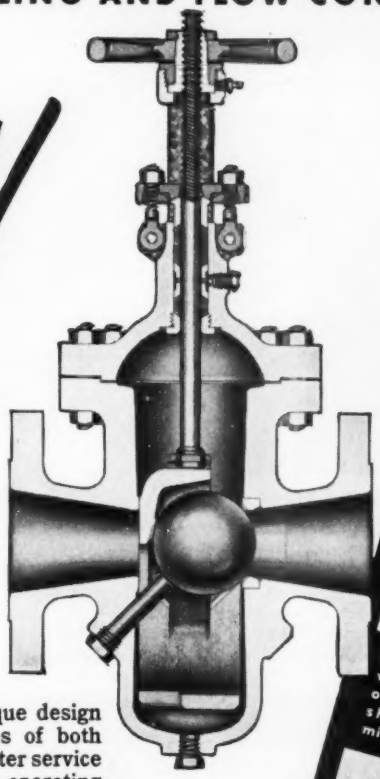
NEW

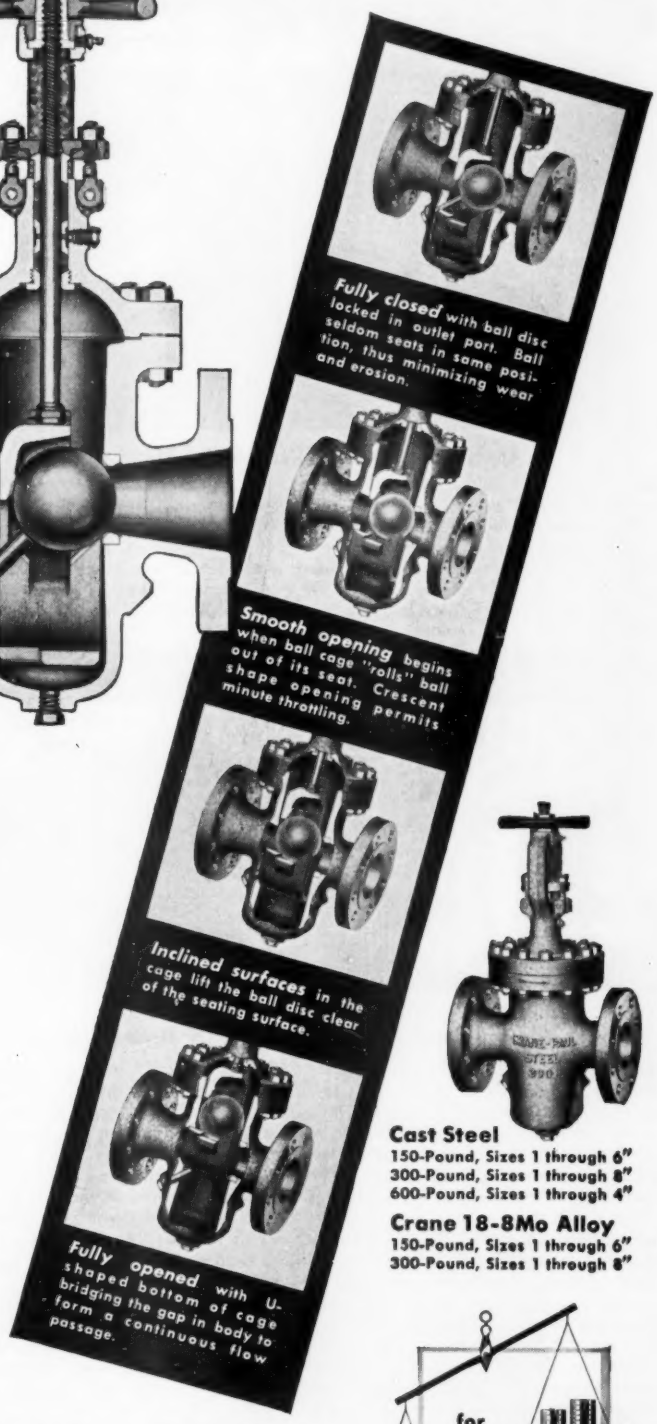


CRANE-PAUL
Venturi-Ball
VALVES

(Patented and Patents Pending)

CAST STEEL OR CRANE 18-8Mo ALLOY

Outside Screw and Yoke—Flanged. Available with sliding stem for assembly with power operators.


Fully closed with ball disc locked in outlet port. Ball seldom seats in same position, thus minimizing wear and erosion.
Smooth opening begins when ball cage "rolls" ball out of its seat. Crescent shape opening permits minute throttling.
Inclined surfaces in the cage lift the ball disc clear of the seating surface.
Fully opened with U-shaped bottom of cage bridging the gap in body to form a continuous flow passage.

Meet the Crane-Paul Valve—a unique design that combines desirable advantages of both gate and globe valves. It provides better service and longer life under more rigorous operating conditions than such valves normally stand. These features include—

Exceptionally accurate throttling with a minimum of wear and erosion, resulting in long-lived seating surfaces.

Straight-through, non-turbulent flow—with pressure drop characteristics approaching those of venturi-type gate valves.

Smooth, easy response throughout the entire range of operation.

Completely tight shut-off.

Heart of this new Crane-Paul Valve is a precision-ground ball disc which rides loosely in a cage direct-connected to the valve stem. In operation, the ball is moved to and from the center of flow and rolls into and out of the body seat. At no time during valve operation does the ball spin or chatter, even in closely throttled positions. It revolves just enough to provide a new seating surface each cycle. In the closed position, part of the ball actually protrudes into the outlet port where it is tightly seated by the wedging action of the ball cage.

Literature Sent on Request

Full information on this new Crane-Paul Valve is in your Crane 53 Catalog. Literature is available from your Crane Representative or on request to address below.

Cast Steel
150-Pound, Sizes 1 through 6"
300-Pound, Sizes 1 through 8"
600-Pound, Sizes 1 through 4"

Crane 18-8Mo Alloy
150-Pound, Sizes 1 through 6"
300-Pound, Sizes 1 through 8"

CRANE VALVES

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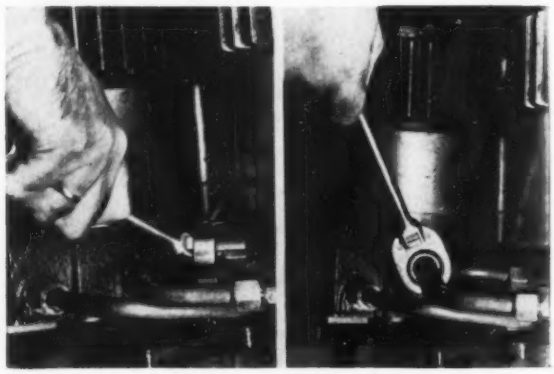
Begins on page 154

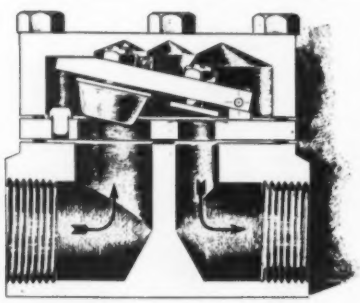


Open End Ratchet Wrench Has Many Uses

359 • Ratcheting socket wrench permits introduction from any side of socket over and completely around a pipe or tube and straight down on the fitting. Manufacturer claims 25 to 90% time savings on hard-to-reach jobs. Wrench engages fittings by literally "surrounding" the standing center obstacle (tube, pipe, conduit, etc.), head ratchets by means of internal pawls. These act on teeth cut into a ring that travels in a circular channel around wrench head.

Thin-walled sockets come in range from ⅜ to 4 in. in 1/16-in. increments, do the work of open-end, adjustable, box, socket and ratchet wrenches. Additional adapters include a turnbuckle, hex, square drive, rigid head, Phillips screwdriver, Allen head, etc.

Tubing Appliance Co, 10321 Anza Ave, Los Angeles 45, Calif.

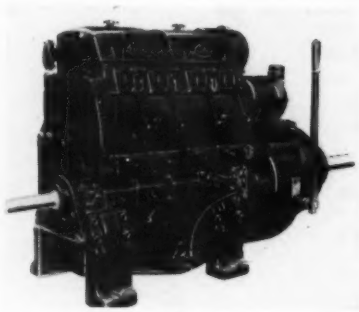


Impulse Steam Trap

310 • New series 50 Yarway impulse steam trap handles large quantities of condensate. Trap maintains high, even temperature in process equipment. Small size and light weight makes it particularly desirable where close quarters piping is involved. The 1½ in. size is 5½ in. long x 5 high x 2/3 wide, weighs only 14 ½ lb. Its maximum capacity is 17,300 lb condensate per hour at 100 psi, condensate 30 F below steam temperature. Constructed throughout of stainless steel, trap is designed for refineries, chemical plants and other heavy duty applications.

Unit has hinged lever and two valves mounted on a valve seat plate; control flow that governs opening and closing action is obtained by allowing small clearance between inlet and outlet valves and their seats when lever is at rest. Bulletin T-1745.

Yarnall-Waring Co, Philadelphia 18, Pa.



Diesel Engines

347 • *Lister* FR line diesels are made in 1, 2, 3, 4, and 6 cylinders, range from 8 to 54 hp. Each cylinder develops 9 hp at 1800 rpm, except the single cylinder engine which develops 8 hp at 1500 rpm.

Engines are totally enclosed, with easily removable covers. Cylinders are permanently impregnated with chromium in a patented process. Chromium cannot peel off or become detached from the wearing surface, manufacturer claims.

Centrifugal governor maintains "settled" speed variation within 2%; automatic release limits overloading to 10%. Individual injection pump for each cylinder is interchangeable with that of any other FR engine.

These diesels are manufactured by R A Lister & Co, Ltd, Dursley, Gloucestershire, England. Upon arrival in the U.S., they are equipped with American accessories, such as starters, generators, radiators, clutches, etc. Parts are stocked by the U.S. distributor.

National Supply Co, Engine Div, 33 Colby St, Springfield, Ohio.

For more data on these items, use post cards, p 163. Identify your request with item number.

Prelubricated Belt Idler

358 • Type UST unit-sealed, prelubricated conveyor belt idler incorporates Timken bearings and Garlock *Klozures*. Unit bearing assemblies provide ample but not excessive grease reservoir, manufacturer claims. Seals prevent grease migration. Lubricant is stable water-repellent grease with wide temperature range. Construction permits operation without re-lubrication for up to three years, depending on severity of conditions.

Continental Gin Co, Industrial Div, Birmingham 2, Ala.

Rotating Steam Joint

342 • *Rotodrain* features an integral drainage control. High capacity air and drainage control unit cuts cost of separate airvents, steam traps, check valves, etc. Any steam locked in the syphon pipe can be discharged through the steam traps, adjusted to have a delayed closing action whenever steam enters the trap body. Integral flow control is installed by a double window in the trap section.

Syphon pipe arrangement can be taken out from the line without removing joints from the cylinder. Syphon pipe itself can be adjusted radially from outside and the adjusting lever indicates position of syphon pipe in cylinder.

Any leakage of the rotating seal is visible in the leakage control tube that connects chamber between seal and bearing with the atmosphere.

An external adjustment increases tension between the carbon ring and washer during operation, to stop leakage. Unit can be taken apart in the line without removing steam joint from cylinder.

Velan Engineering Co, 1 Exchange Place, Jersey City, N. J.

Rotary Broach

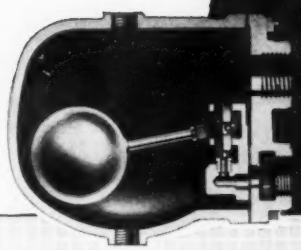
321 • New tool is claimed to finish holes within ±.0001. Rotary broaches remove metal by a shear-cutting action, which forces chip ahead of the tool.

Cutting edge is 10 to 20 times longer than cutting edge of a standard reamer. Manufacturer claims tool life is 5 to 50 times greater than the tool it replaces. Rotary broaches can be re-sharpened 10 to 30 times before they produce an undersize hole. Sizes from 1/16 to 3 in. in one sixty-fourth in. increments are now available.

Shearcut Tool Co, 7045 Darby Ave, Reseda, Calif.

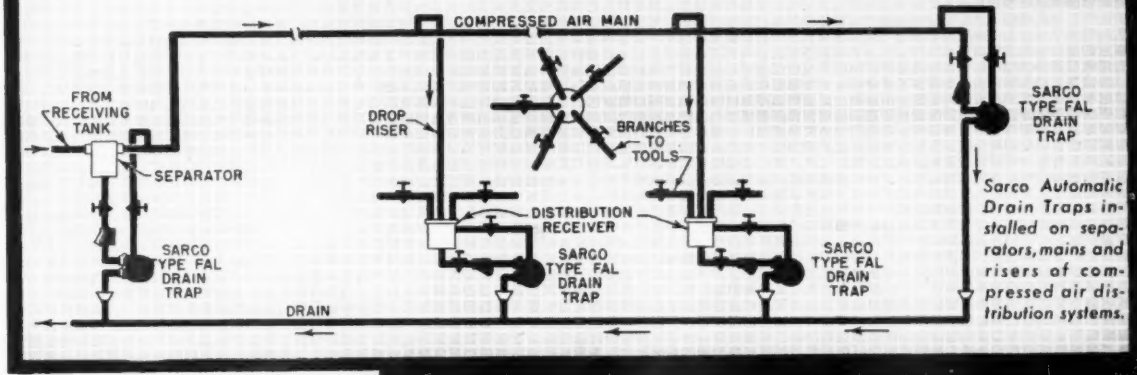
(*Continued on page* 158)

Sarco Drain Trap type FA, sizes ¾" and 1", pressures to 750 psi. Floats, valve seats and discs are of stainless steel.



REMOVE WATER

Series 52 No. 5



Sarco Automatic Drain Traps installed on separators, mains and risers of compressed air distribution systems.

...from compressed air

with SARCO automatic drain traps

MOISTURE condensing from compressed air in mains and distribution lines must be removed as soon as it collects. Otherwise there will be damage to tools, marred paint surfaces, or wetting of material to be cleaned, especially electrical machines and sand molds.

Water accumulating at the base of risers or low points in the lines may also cause water-hammer and trouble from freezing.

Sarco Drain Traps should be installed at the aftercooler, on separators, at the receiver and on low points in the lines, to remove water as quickly as it collects.

At nominal cost, these traps will greatly improve your compressed air operation.

Sarco Company, Inc., Empire State Bldg., New York 1, N.Y. Represented in principal cities. Sarco Canada Ltd., Toronto 8, Ont.

TECHNICAL BULLETIN NO. 5-CA *will help you get more work from your air compressors at less cost. Write for your copy.*

SARCO saves steam

improves product quality and output

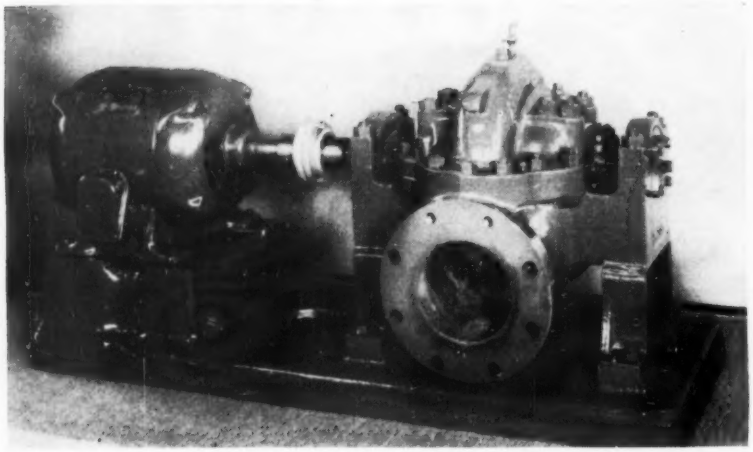
Sarco type FA Drain Trap removing separated water from aftercooler of air compressor.

Sarco automatic Drain Traps, type FA, removing water from compressed air separators.

413

More EQUIPMENT NEWS

Begins on page 154



Centrifugal Pump Series

319 • New series of single stage, double suction centrifugal pumps is designated the Fig. 3405 pumps. Standard features include renewable stuffing box bushings, sealed bearing housings, cowl-type glands suitable for use with quenching liquids, stainless steel impeller keys, *Teflon* water seal rings, die-formed stuffing box packing, and corrosion-resistant gland bolts.

Bearing spans have been kept to the shortest practical distance, resulting in overall savings in length up to 50%. Casings are horizontally split, and removing upper half permits removal of entire rotating element without disturbing suction and discharge piping, or pump and driver alignment.

There are three different assemblies and 19 different pump sizes in the three groups. Impeller rotation can be reversed without additional parts. Motor, belt, or turbine drives are available. Impeller is double-suction type, cast in one piece of iron or bronze.

Packed type stuffing boxes are standard, but single or double mechanical seals can be furnished on order. All mounting dimensions of all pumps within each group are identical, and motor drive bedplates are standardized.

Gland and seal assemblies meet specifications of the petroleum refining industry. Bearing housings are sealed, making Fig. 3405 pumps suitable for outdoor installations. Capacities range from 200 to 6400 gpm, with heads up to 260 ft.

Goulds Pumps, Inc, Dept PR, Seneca Falls, N. Y.

Time Totalizer

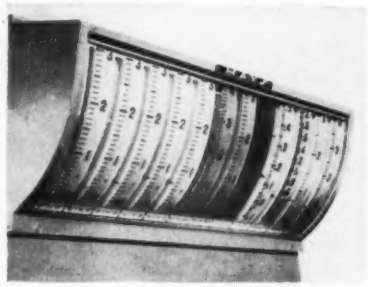
303 • Type ET time totalizer measures and indicates elapsed time intervals wherever very precise measurement of time is required. Two models are available: One has scale divisions of 0.01 second and a total range of 60 seconds, and the other has divisions of 0.01 minute and a total range of 60 minutes. Accuracy for either is better than 0.2%. Applications include timing operations in industrial laboratories, or for measurement and control of processes in the chemicals or metals industries.

Differential clutch mechanism insures high accuracy and positive clutching. Motor is permanently connected to the sun gear of a differential gear system. One of the differential members is connected to the pointer system, the other to a free gear.

When timer is energized, solenoid-operated pawl stops the free member, and power is immediately transferred to the pointer member. When the timer is de-energized a pawl engages the pointer gear, stopping it instantly, while the free member is simultaneously released. Bulletin 690.

R W Cramer Co, Centerbrook 5, Conn.

For more data on these items, use post cards p. 163. Identify your request with item number.



Draft Gage

306 • Hays *Vertiscale* incorporates 3-way atmospheric vent; easy "one man" zero check; large identification label space; magnetic access door; fluorescent lighting; removable units; no paralax.

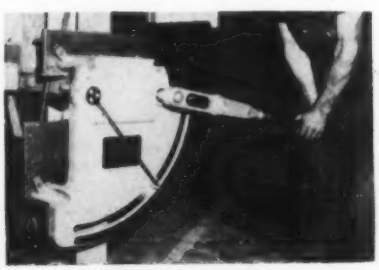
Basic operating mechanism consists of a diaphragm enclosed in a cast metal housing. Force and movement of diaphragm is balanced against force of calibrating springs. Resultant diaphragm movement is transmitted through linkage to the pointer to indicate magnitude of the draft, pressure or differential.

From one to twelve units can be mounted side by side in a single case. Four mountings available: semi-flush, recessed, eye-level and projected or lug types.

Unit can be equipped with a spring-loaded metallic bellows for indicating level, flow, temperature, and pressure pneumatically transmitted by other instruments. Ranges from .2 to 120 in. of water, draft, and differential can be provided. Bulletin 52-1060-210.

Hays Corp, Michigan City, Ind.

(*Continued on page* 160)



Torque Tester

353 • Two torque trainer-testers provide visual means of gaging torque accuracy. Tester permits quick check or torque wrenches, and automatically teaches the proper way to apply force to a wrench, manufacturer claims. Model 71, for heavy-duty wrenches, has a range from 0 to 350 ft-lbs. Model 73, for standard duty wrenches, has a range from 0 to 1200 in-lbs. Both models are designed for wall mounting, are guaranteed accurate within 2% of full scale.

B K Sweeney Co, Dept 33, 1601 23rd St, Denver, Colo.

Ac Aircraft Motor

313 • New 400 cycle, 3-phase ac motor is rated for 16 hp intermittent duty. Weighing only 28 lbs, this motor offers internal gearing for multiplied torque at low speeds. Wide range of gear ratios permits output shaft speeds from 1500 to 5000 rpm. Designed to meet the requirements of Air Force specification 32590, this unit is designed for duty with hydraulic pumps, compressors and hoists.

U.S. Electrical Motors Inc, Aircraft Div, Terminal Annex (Box 2058), Los Angeles 54, Calif.

It is significant that year after year important users of condenser tubes and plates specify Revere, not only for new equipment, but when re-tubing. You might consider this fact if you are not as yet a Revere customer.

Remember that Revere can give you more than tubes and plates. If you have questions regarding the most suitable alloy to meet operating conditions, the Revere Technical Advisory Service will be glad to collaborate with you on this subject. If your present tubes do not seem to be giving the service expected of them, the same Service will look into the matter. Such factors as vibration, air entrainment, water velocity, impingement attack, changed water conditions, tube composition, and others will be studied and recommendations made. In a great many cases we have pointed the way to greater tube economy, increased service life.

As part of our service to condenser operators we have prepared a 28-page booklet entitled "Life Extension for Condenser Tubes." Ask for it on your company letterhead and it will be sent free.

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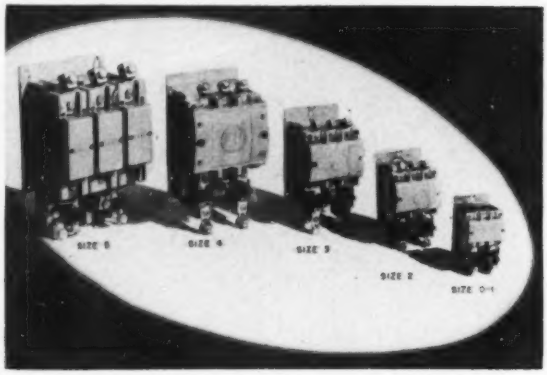
More EQUIPMENT NEWS

Begins on page 154



Magnetic Motor Starter

305 • Type RA-V magnetic motor starter features vertical overloads below the contactor. It is designed especially to be used with the new Crouse-Hinds M52, type EPC explosion-proof condulet.

Unit has smaller size and lighter weight than conventional controls. Smaller condulets are required and installation is faster and easier. Two men can readily hang even the largest sizes. Size 2 starter requires only 7 in. condulet instead of the usual 9 in. Similarly, size 3 starter requires only 9 in. condulet instead of the usual 11 in.

Manufacturer claims to have the only size 5 starter on the market that can be housed in an EPC condulet.

Industrial Control Div, Arrow-Hart & Hegeman Electric Co, 103 Hawthorn St, Hartford 6, Conn.

Worm Gear Speed Reducer

354 • *Type hat* speed reducer incorporates automatic and instantaneous shut-off device for overload protection. Known as double torque control, this feature is claimed to eliminate need for a shear-pin coupling. Direct mechanical action cuts off current when load limit is reached.

Restarting requires only removing excessive load. Recommended uses include drives for conveyors, stokers, rolls, tumblers, etc. Ratio from 3⅝ to 1 up to 6300 to 1 are available.

Philadelphia Gear Works, Inc, Venango & G Sts, Philadelphia 34, Pa.

For more data on these items, use post cards p. 163. Identify your request with item number.

Generator-Motor Cleaner

322 • New solvent cleans electric motors and generators while they are still assembled. Equipment can be cleaned two ways: (1) A motor can be completely submerged in cleaner, then plugged into electric current and allowed to run from 3 to 5 min. Motor is then dried with compressed air. (2) Cleaner may be sprayed into intake side of a motor, while it is in operation.

Motors that have been accidentally submerged in water as a result of fires, flood, etc, may be cleaned without "baking." Cleaner does not affect wiring or insulation that is gasoline- or oil-resistant, manufacturer says.

The Shaler Co, Waupun, Wis.

Solder Paste-Flux

325 • New paint-on solder paste combined with flux, trade-named *Eutec-TinWeld*, is claimed to increase speed of application while cutting waste to a minimum.

Paste consists of a specially formulated lead-tin-solder that is pre-mixed, in proper proportions with its accompanying flux. Product has capillary flow similar to silver solder with strengths equivalent to conventional lead-tin solders. Flux residue can be washed off with plain water.

TinWeld can be used with torch, furnace or soldering iron to join all metals except aluminum and magnesium. No additional or outside flux is required.

Eutectic Welding Alloys Corp, Dept P, 172nd St and Northern Blvd, Flushing 58, New York, N. Y.

CHECK THESE TOO! . . .

Door-Step Threshold ..... p 168
Package Boiler ..... p 170
Industrial Puller Set ..... p 172
Boiler Level Indicator ..... p 174
Low-Speed Motor ..... p 176
High-Pressure Gage ..... p 178
Zipper Bunker Seal ..... p 180
Industrial Television ..... p 184
Glass Fiber Insulation ..... p 186
Load Interrupter ..... p 188

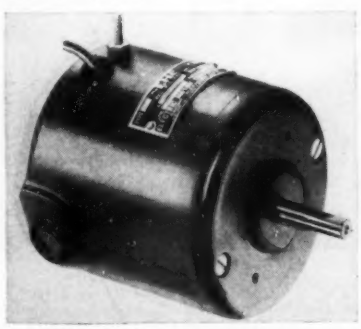
Overload Relay

327 • New type of overload relay combines high speed operation under dangerous conditions with time delay for starting inrush.

Type C *Silic-O-Netic* relay can be furnished with time delay curves to match the characteristics of the protected equipment. But it provides a definite high speed response point at eight times rating, protecting hermetically sealed motors, electronic circuits and control systems.

Relay has a hermetically sealed brass tube extending through and beyond the solenoid coil. Tube, in turn, holds a movable iron core and is filled with a silicone liquid. On starting inrush or small overloads, magnetic force is not sufficient to attract the armature. However it draws core into field at a rate controlled by the silicone viscosity. When core reaches pole piece the relay responds, providing delayed response. On large overloads relay operation is instantaneous. Relays are insulated for 440-v service with coil ratings from 1 to 100 amps. Bulletin 5101.

Heinemann Electric Co, 371 Plum St, Trenton 2, N. J.



Fractional Hp Motor

335 • New EMC Model 710 motor is designed for use as a blower or fan motor for refrigeration space cooler or space heater applications. It is series wound and can be furnished either ac or dc, with voltage range of 6, 12, 24, 32 to 115.

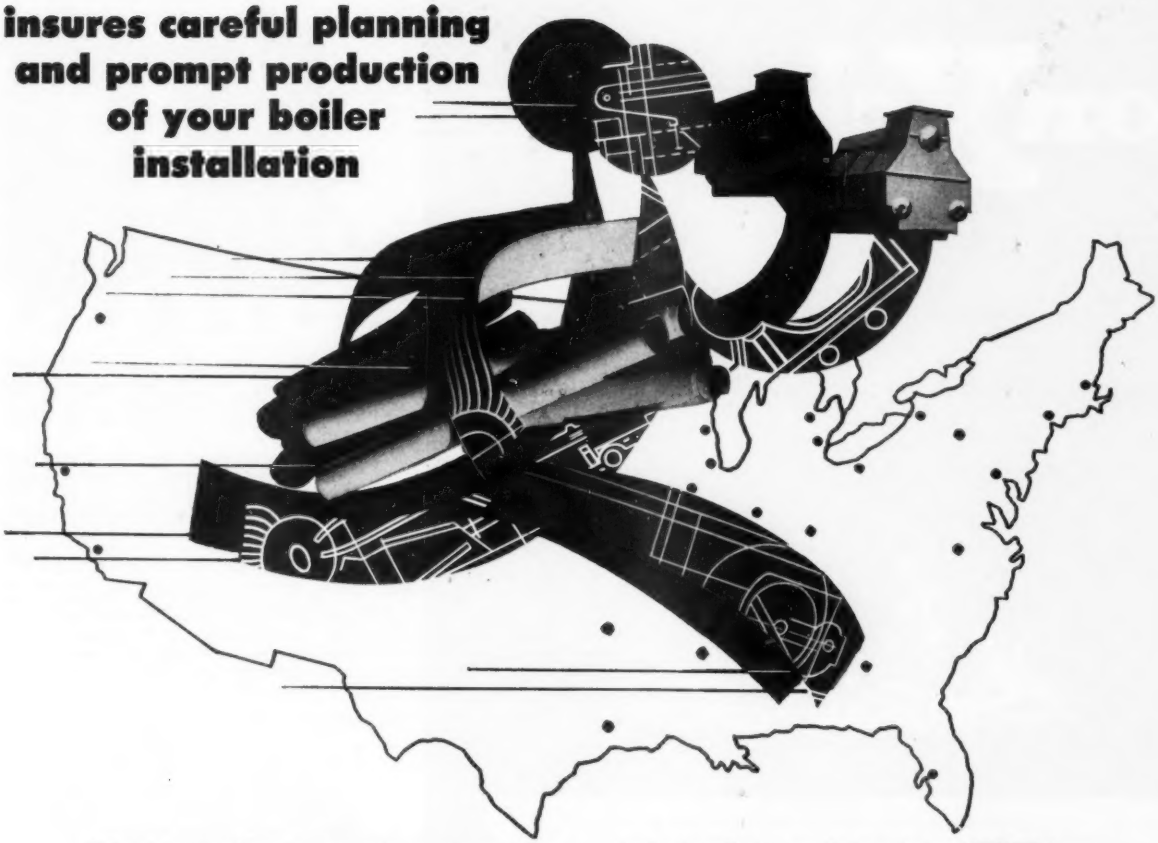
Model is rated from 1/30 to 1/15 hp—case is totally enclosed type and will stand water submersion and a wide range of temperature changes. Mounting is either band or flange type.

Howard Industries, Inc, Electric Motor Corp Div, Racine, Wis.

(*Continued on page* 168)

WICKES SERVICE

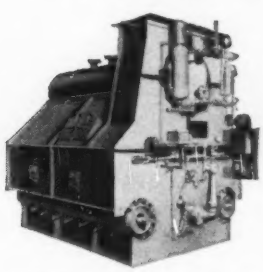
insures careful planning and prompt production of your boiler installation



When you need steam generating equipment, you want to be able to work out your requirements with experienced men who are near at hand and know boilers thoroughly. That's where WICKES can help you, because WICKES has factory-trained sales engineers in twenty-three principal cities in the United States and several industrial centers outside the country. These men are ready to help you plan your new boiler installation.

And when your plans are settled, you want your equipment installed as soon as possible. That's when WICKES engineers and production men swing into action. They rush to get your new boiler installation ready in a hurry. WICKES handles all the details—from the time the first drawings are made to the day you raise steam pressure. Then, for the life of the boiler, WICKES sales engineers and maintenance men are available day and night to keep your equipment operating at peak efficiency.

WICKES can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers, adaptable to any standard method of firing. Write today for descriptive literature or consult your nearest WICKES representative.



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DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

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RECOGNIZED QUALITY SINCE 1854

146

ionXchange

pioneers and leaders in ionXchange

ILLCO-WAY "firsts" include manufacture of the first commercial two-bed De-ionizer . . . the first commercial mixed-bed De-ionizer . . . and the development and building of the first successful installations for the purification of such liquids as beet-juice and crude glycerol by ionXchange . . . In the power field, boiler feed water treatment by ILLCO-WAY ionXchange has long meant lower operating costs and increased operating efficiency. Installations in leading plants.

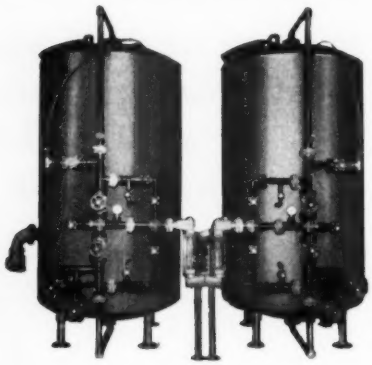
ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

For complete data, see Sweet's File, Power Plant

(Advertisement)

SOLIDS-FREE WATER



Illco-Way De-ionizing installation (*above*) produces 5,000 gph of solids-free water for high-pressure boiler operation in an Eastern plant.

This is typical of Illco-Way equipment designed and fabricated to meet specific power plant requirements.

Illco-Way ionXchange is utilized in three types of processing:

DE-IONIZING

Illco-Way De-ionizers for solids-free water; manual or fully automatic operation. Provide complete removal of ionizable solids down to less than 1 ppm, 0.02 ppm or less silica, and zero CO_2. Equipment designed to meet specific requirements.

HYDROGEN ZEOLITE

For medium pressure operation, Illco-Way hydrogen zeolite units provide a feedwater with controlled alkalinity and zero hardness. Equipment is compact, easy to operate, designed to specific requirements.

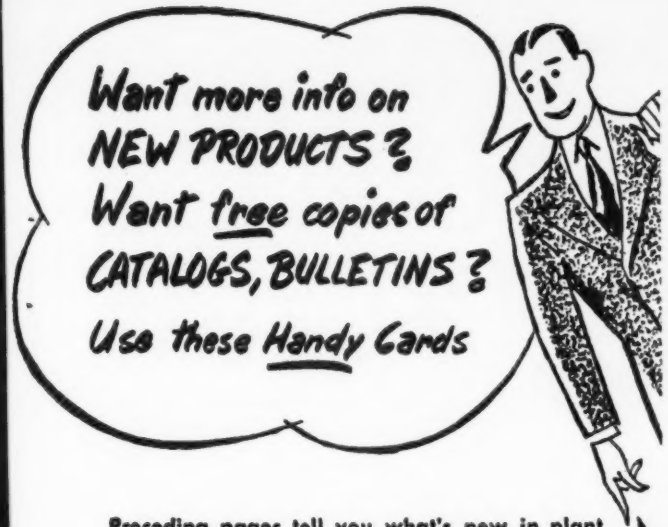
SOFTENING

Illco-Way softening equipment provides a hardness-free water for low-pressure boiler operation. Softeners are designed for either manual or fully automatic operation and sized to provide specified volumes of soft water.

Illco-Way equipment, used in America's outstanding plants, includes the recently developed Mixed-Bed De-ionizers, Hydrogen-Zeolite Units, Zeolite Softeners, Degasifiers, Filters.

POCKET CALCULATOR

A handy ionXchange calculator for conversion of water analysis has been developed by Illco-Way. The easily read sliding scale is used to convert ppm to gpg as $CaCO_3$. This accurate pocket-piece is helpful to anyone operating water treatment equipment or to engineers specifying such equipment. Request for one of these Calculators should be sent to Illinois Water Treatment Co., Rockford, Ill., on your company letterhead.



Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

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This month's FREE Literature

BOILERS AND ACCESSORIES

1 **INTEGRAL FURNACE BOILER**—bi-drum, water tube, 40,000 to 250,000 lb per hr, to 900 psi and 900 F. Publication No. 1525, 20 pages, illust. Babcock & Wilcox Ltd, Babcock House, Farringdon St, London, E.C. 4, England.

2 **INDUCED-DRAFT FANS** — motor driven, axial flow, in divided housing, 12 to 36 in. diameter fans, 1/12 to 15 hp motors. Bulletin DB-32-52, 8 pages, specs, dimensions. DeBothezat Fans Div, American Machine & Metals, Inc, East Moline, Ill.

3 **SCOTCH BOILERS**—and water wall furnace extensions. Scotches from 1,000 to 25,000 sq ft of surface. Bulletins SMB-1 and WWF-1. Crotty Mfg Corp, 133-15 35th Ave, Flushing, N. Y.

4 **PROPORTIONAL MIXERS**—for low pressure air-gas, one valve control. Catalog No. 805A, 12 pages, specs, data. Hauck Mfg Co, 124-136 10th St, Brooklyn 15, N. Y.

ELECTRICAL AND MECHANICAL CONTROLS

5 **AIR CONTROL VALVES** — integral pilot operated, remote controlled, and direct operated. Bulletin No. 101A, 12 pages, illust. Ross Operating Valve Co, 120 E Golden Gate Ave, Detroit 3, Mich.

6 **INDUSTRIAL CONTROLS** — Temperature and humidity, motor operated valves, control motors. Catalog F 3941-2, 32 pages. Barber-Colman Co, Rockford, Ill.

★ **REGULATORS**—for pressure and temperature, pump governors, how to select, with steam, gas and water capacity tables. *Step Selection Chart*, 36 pages. Request direct on Company letterhead to Foster Engrg Co, Union, N. J.

ELECTRICAL EQUIPMENT

7 **INSTRUMENT TRANSFORMER** — buyer's guide with ratings, ASA accuracy data, prices of indoor, outdoor potential and current transformers. GEA-4626F, 102 pages. General Electric Co, Schenectady 5, N. Y.

8 **COMMUNICATIONS** — two-way radio for material handling, service, protection. ECR-47, 8 pages. General Electric Co, Advertising Inquiry Sec, Electronics Park, Syracuse, N. Y.

9 **MOTORS**—instrument and timing, gear, synchronous and non-synchronous, specs, illust, ratings, dimensions. 10 pages. Gleason-Avery, Inc, 45 Aurelius Ave, Auburn, N. Y.

10 **ELECTRICAL TAPES**—and related electrical products for construction and maintenance. 12 pages, illust. Minnesota Mining & Mfg Co, 900 Fauquire St, St. Paul 6, Minn.

11 **METALLIC RECTIFIER**—power conversion units. Design, performance, circuits, applications, dimensions, ratings, weights. GEA-5658A, 8 pages. General Electric Co, Schenectady 5, N. Y.

12 **INDUSTRIAL POWER DISTRIBUTION** — idea book for large and small plants. Covers power buying, voltage choice, circuit breakers, cables, distribution systems, grounding, capacitors, direct current, etc. GEA-5900, 28 pages. General Electric Co, Schenectady 5, N. Y.

INSULATION, HEAT, COLD

13 **LAGGING ADHESIVE** — plasticized synthetic resin emulsion for steam, hot, cold water lines, boilers, storage tanks, etc. 8 pages. Arabol Mfg Co, 110 E 42nd St, New York 17, N. Y.

14 **INSULATION SPECS**—for oil refineries and chemical process plants. Gives material, engineering, application, thickness recommendations. 52 pages, illust. Johns-Manville, 22 E 40th St, New York 16, N. Y.

(Continued on page 254)

HERE'S YOUR *Complete* STEAM PLANT

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
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- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.
- For complete details, write today for catalog 501.

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES, Inc.

Factory: Emmaus, Pa.

Executive Offices: Times Building, Times Square, New York 18, N. Y.

Square Peg?

"I'M SORRY," said the personnel officer to our plant superintendent's son, "But you can't have the job." With your IQ of 142, you're too intelligent to do repetitive work like running an adding machine. You'd tire of it in a few hours. Find something that taxes your imagination."

That advice was a slap to my friend's brilliant son, but it was sound. In one of my early plants, a crackerjack lathe hand had started making costly mistakes. Finally he told the boss he was quitting—said he was getting tired of doing the same thing day after day.

"Look," said the sharp plant engineer. "Let me put you in the power-house maintenance gang. You'll be all over the place and each job will be different. If you don't like it after one month, you can quit."

That was in 1929. The ex-lathe operator is now the plant engineer of the entire works. He had too much imagination to be making the same parts, day after day, on the same machine. Cut loose from his lathe, he did more things to keep a lame machine running than anyone I had ever seen. Before long we all asked his advice on maintenance short cuts. At last he was a square peg in a square hole.

Ever think of shifting your gang around to keep them satisfied? Whatever you do, don't smother a guy who has ideas by snowing him under with monotonous details. Cash in on his natural ability.

George Edwards

Engineer

BOILER CLEANED CLEANER BY DOWELL SERVICE

Chemical solvents removed 1650 lb. of deposits from boiler previously "cleaned" by turbining

When you consider that liquid chemical solvents will reach wherever water will flow, you can soon appreciate the many advantages of cleaning with chemistry.

Where mechanical devices, rattling, and turbining fail to clean—in crevices, around angles, through openings—Dowell solvents are designed to dissolve and loosen scale and sludge . . . carry away these profit-stealing deposits quickly and easily.

For example, Dowell recently cleaned a 150,000 pph boiler that had previously been turbine-cleaned. Although the chemical cleaning required only a few hours, Dowell engineers removed 1,650 *additional* pounds of deposits from the boiler. Best of all, no scaffolding or dismantling of equipment was necessary. Dowell-designed equipment was used to introduce special liquid solvents through regular connections. Downtime was kept to a minimum.

What is *your* cleaning problem? Dowell has extensive experience in cleaning all kinds of process and heat exchange equipment. Dowell furnishes trained personnel, pump trucks, and control equipment.

Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing.

For further details or estimates, call your nearest Dowell office or station. Or write to Tulsa, Dept. C-23.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

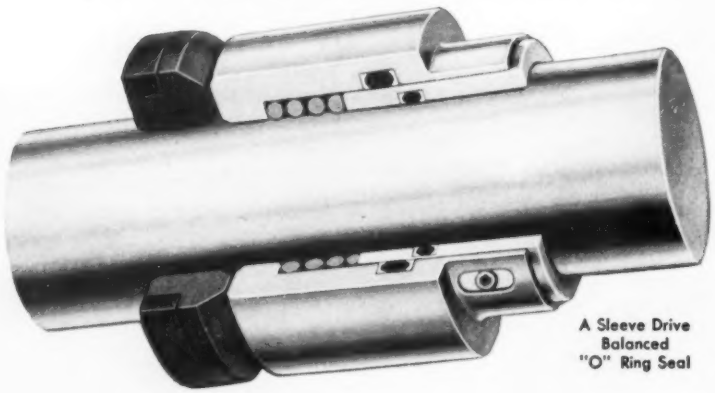
DOWELL INCORPORATED • TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

Garlock "O"-Ring Seals

FOR ROTATING PUMP SHAFTS



A Sleeve Drive Balanced "O" Ring Seal

Simple in Design, Leakless in Operation

GARLOCK "O" Ring Mechanical Seals are made with a minimum of parts. This simplicity of design affords easy manufacturing adaptability of a Garlock "O" Ring Seal to withstand any liquid, whether mild, harmfully corrosive or extremely hazardous, on rotating pump shafts. The Garlock "O" Ring Balanced Seal will hold pressures up to and over 1000 p.s.i.

The "O" rings are available in "Teflon," Buna-N, Neoprene or Silicone. The metal parts contacting the liquid are available in any suitable metal.

On centrifugal pumps handling chemicals, petroleum products, edible liquids, pulp liquors, and many other liquids Garlock "O" Ring Mechanical Seals are giving outstanding service.

For positive sealing, easy installation and trouble-free service use Garlock "O" Ring Mechanical Seals on your rotating pump shafts. Write us about your sealing problems or contact your Garlock representative.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS

More EQUIPMENT NEWS

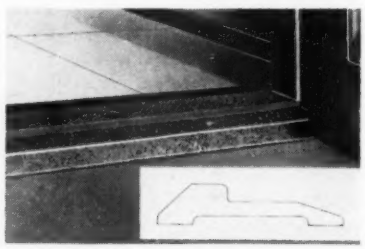
Begins on page 154

Set Screw

332 • *Nu-Cup* set screws have the cup point designed so user obtains greatly increased holding power with same amount of setting torque. Diameter of the cup circle is larger, providing fuller contact and deeper impression into the shaft plus greater resistance to reversal. Distribution pressure is spread over 20 to 25% more area than with conventional set screws.

Screws are particularly suited to applications where shaft is soft, or small in relation to contact arc of the screw cup.

Set Screw & Mfg Co, 193 Main St, Bartlett, Ill.

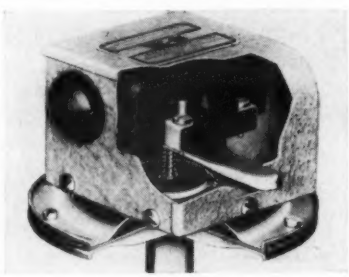


Door-Step Threshold

318 • New door-step threshold has non-slip surface and beveled edges front and back. Wooster type 115-S has Standard widths of 4, 5 and 6 in., maximum length of 6 ft. The threshold is made of abrasive iron and aluminum, also bronze and nickel when permitted.

Wooster Products, Inc, Dept P, Wooster, Ohio.

For more data on these items, use post cards p. 163. Identify your request with item number.



Vacuum Switch

301 • Vacuum switch shuts off the power source when liquid supply runs dry. Designed for use with electric motors and gasoline engines, *Vac-on* switch can be used as circuit-breaker or control where safety of equipment depends on a suction-delivered lubricant, fuel, water or similar liquid. Switch also serves as a warning control where operating conditions depend on vacuum.

Unit mounts on the suction line and is wired into the power supply on electric motors, or the spark system on gasoline engines. When suction falls below a predetermined negative pressure (approximately 1 in. mercury) the switch auto-

SERVICE PIN... for you, too

Chances are you've seen this pin. It represents 15 years of service with Socony-Vacuum. Six out of 10 of our industrial engineers and salesmen wear it. Four out of 10 have served over 20 years. In fact, the average length of service of *all* Socony-Vacuum lubrication and process products representatives is almost 17 years! All this petroleum engineering experience, the world's greatest, is yours when you call on Socony-Vacuum. Why accept less for *your* plant?

Socony-Vacuum
Correct Lubrication

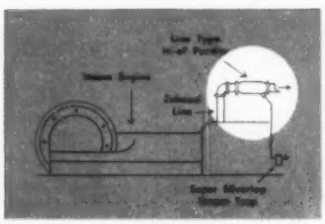
SOCONY-VACUUM

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:
MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

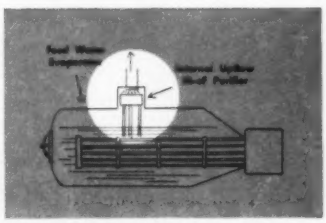
A POWER ENGINEER'S Best Friend

ANDERSON Hi-eF PURIFIERS

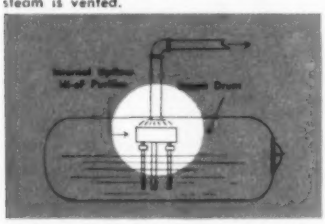
Watchdogs of Steam Pipelines and Equipment



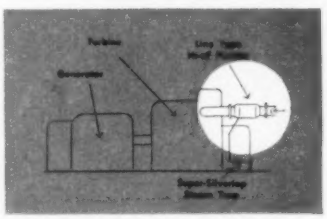
EXHAUST STEAM LINES—Hi-eF Purifiers clean up exhaust steam. Permits it to be returned to the boiler as condensate free of hazardous oil and other entrainment. Exhaust Head Hi-eF Purifiers for stacks overcome nuisance problems arising when highly contaminated steam is vented.



FEED WATER EVAPORATORS—A Hi-eF Purifier placed in the feed water evaporators outlet pays for itself by keeping carryover down to ½ P.P.M. of solids or less, eliminating the problem of solids in the feed water.



BOILERS—Hi-eF Purifiers are 99% efficient in the removal of dirt and moisture. If the steam in your boilers has 90% initial quality, a Hi-eF Purifier will increase the final quality to 99.9%!



LIVE STEAM LINES—One failure of an unprotected turbine or reciprocating engine is much more costly than a Hi-eF Purifier. Removes all line scale, slugs, moisture, mineral salts and dirt that builds up, erodes and corrodes equipment.

● The use of Hi-eF Purifiers assures quality steam . . . efficient, clean, dry steam . . . throughout your entire power generation and distribution system. Easy to install these maintenance-free units have no moving parts . . . consequently never wear out, never need maintenance. They pay for themselves over and over again by removing all moisture, mist, slugs, carryover, oil and dirt particles from steam that damage equipment, cause costly downtime, heat loss and otherwise impair the operating efficiency of your plant. Mail coupon for complete information.

THE V. D. ANDERSON COMPANY

1934 West 96th Street • Cleveland 2, Ohio

Please send information on the following types of purifiers:

☐ Line Type ☐ Internal Type ☐ Receiver

*Name*_____ *Title*_____

*Address*_____

*City*_____ *State*_____

BY THE MAKERS OF SUPER-SILVERTOP STEAM TRAPS

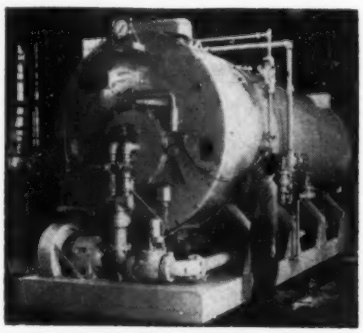
More EQUIPMENT NEWS

Begins on page 154

matically cuts off the motor or gas engine.

Model for motor use will operate on electric motors up to 2 hp ac, and ½ hp dc. Gas engine model will short out the spark plug in event of liquid supply failure.

Jaycon Associates, 404 N Washington Ave, Minneapolis, Minnesota.

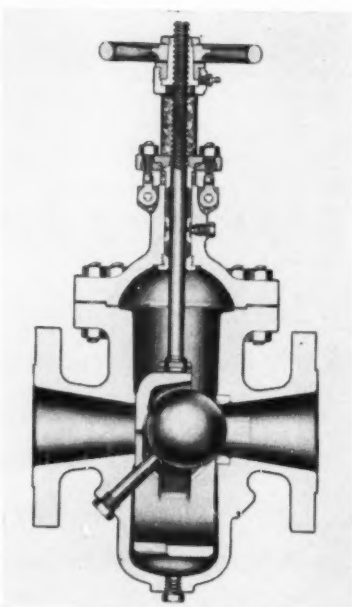


Package Boiler

345 • New 600 hp unit has been added to the line of *Amesteam* generators. Twenty sizes are now available from 10 to 600 hp, for pressures from 15 to 200 psi, firing with oil, gas or oil-gas combinations.

Ames Iron Works, Inc, Box R-2, Oswego, N. Y.

For more data on these items, use post cards p. 163. Identify your request with item number.



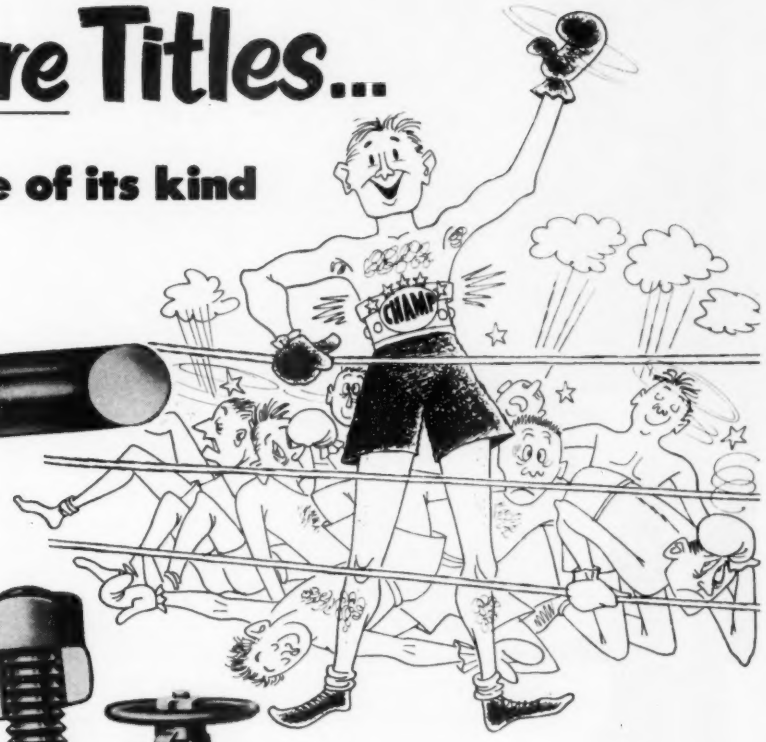
Venturi Ball Valve

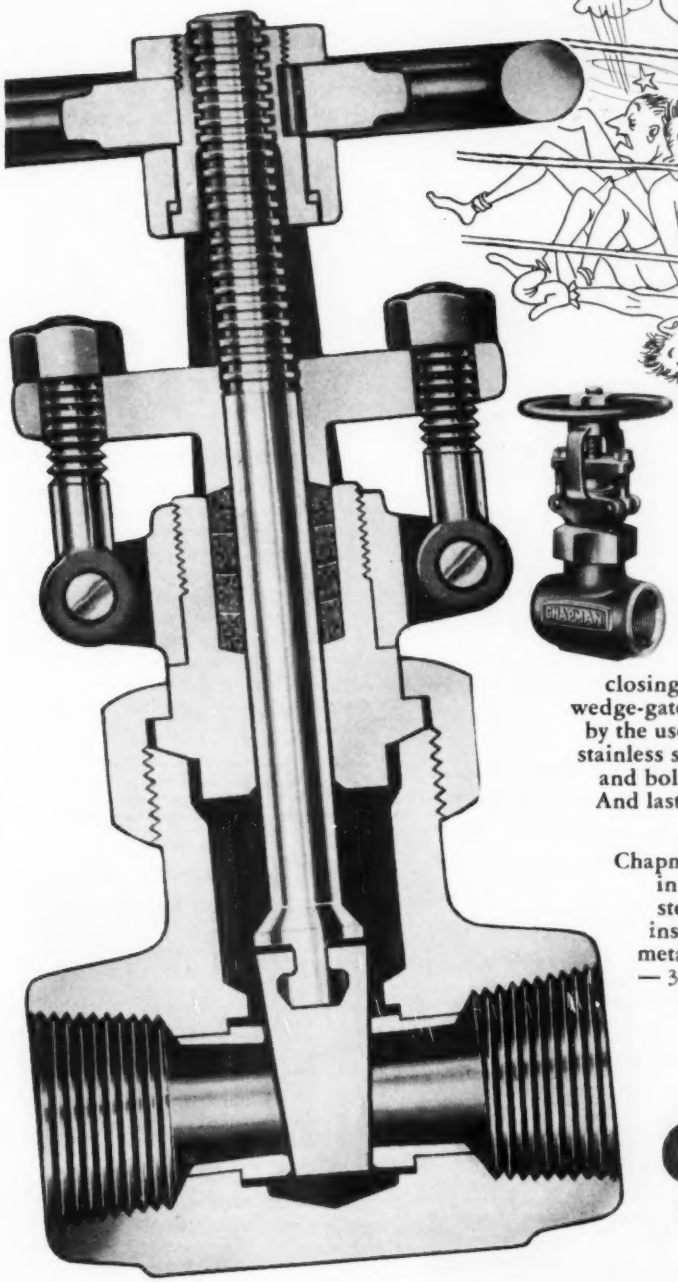
311 • *Crane-Paul* valves have ball-shaped disc that rides in a cage attached to stem by tee-head slotted construction. In operation, ball moves to and from center of flow and rolls into and out of body seat. Ball disc is mechanically locked in closed posi-

CHAPMAN LIST 960

Holds More Titles...

than any valve of its kind





Yes, here's the champ of all small forged steel gate valves! It has licked more different jobs than you can shake a stick at . . . and stays in there fighting with all the *extra stamina* you get in *every* Chapman Valve.

Here are the reasons why: Extra protection against even unusual stress when opening and closing the valve is provided by extra-strong stem-and-wedge-gate connection. Repairs and replacements are cut by the use of super-hardened seat rings and gate faces of stainless steel. Forged body and yoke are longer-lived . . . and bolted follower has no threads on yoke to corrode. And lastly, gate faces won't seize or gall because they're *Malcomized* (Chapman patent) to 800 Brinell.

Chapman List 960 Forged Steel Gate Valves are made in sizes from ½" to 2" inclusive . . . with rising stem with yoke (shown) or with rising stem with inside screw. Bonnet joints are either gasketed or metal to metal. Pressure range: 2,000 lb. at 100° F. — 380 lb. at 1,000° F. For higher pressures, specify List 990. And for full details on List 960, send today for your copy of Catalog 10.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASS.

Pumping Quality- into Fine Paper

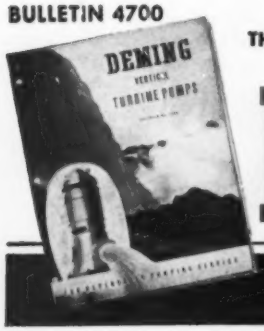
"Fine Paper at its Best" is the famous slogan of the Rising Paper Company, Housatonic, Massachusetts. The first "must" in the manufacture of Rising Papers is pure, crystal clear water.

It takes a lot of water—100 gallons—to make a pound of paper. At the Rising Paper Company, millions of gallons of crystal clear water are pumped from an 8-inch well, 600 feet deep at the rate of 550 gallons per minute against a head of 110 feet.

This service is performed by the Deming Vertical Turbine Pump illustrated. Installed in 1940 by the Artesian Well Supply Co., Providence, R. I., the Deming Turbine Pump is "very satisfactory," according to Mr. F. E. May, President, Rising Paper Co.

Investigate the advantages of Deming Vertical Turbine Pumps. Write for Bulletin 4700.

BULLETIN 4700



THE DEMING COMPANY • 547 Broadway, Salem, Ohio

Deming PUMPS

More EQUIPMENT NEWS

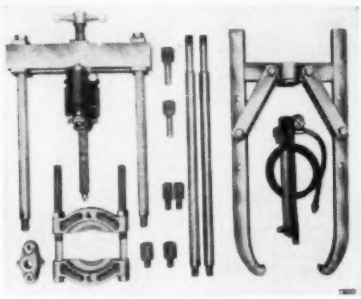
Begins on page 154

tion by a wedging member on the cage. In moving to fully open position, ball rolls out of seat and up, until it is lined up vertically with stem and is carried out of the flow path.

Design provides accurate flow control with a minimum of wire-drawing; straight-through flow with low pressure drop; tight shut-off; easy operation; and freedom from vibration or chattering, regardless of position of ball disc.

Valves are available in venturi patterns, with flanged ends, in cast carbon steel and *Crane* 18-8 Mo alloy steel, and in a wide range of sizes beginning at 1 in. Cast steel valves are available in 150, 300, and 600-lb classes, and alloy valves in 150 and 300-lb classes.

Crane Co, 836 S Michigan Ave, Chicago 5, Ill.



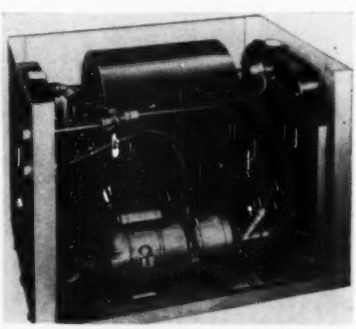
Industrial Puller Set

329 • Giant industrial puller set is useful for maintenance operations involving removal and installation of gears, bearings, pulleys, wheels, pinions, shafts, etc.

Set includes the new 50-ton *Power-Twin* hydraulic unit to provide the power, together with suitable pullers and attachments. Three-speed hand pump or an electrically driven pump is available to speed up these jobs even more.

Owatonna Tool Co, 378 Cedar St, Owatonna, Minn.

For more data on these items, use post cards p. 163. Identify your request with item number.



Water Cooler-Recirculator

337 • Water-cooling and recirculating unit has been developed for use with Chrysler Airtemp 3-hp packaged air conditioners.

The *water saver* takes the place of out-

ANKORFLEX

. . . so versatile it can be used for largest hydraulic plungers down to smallest valve stems.

BRANCHES

BOSTON, MASS. • NEW YORK, N. Y.
CHICAGO, ILL. • PHILADELPHIA, PA.
DETROIT, MICH. • PITTSBURGH, PA.
LOS ANGELES, CAL. • ST. LOUIS, MO.
NEW ORLEANS, LA. • SEATTLE, WASH.
SAN FRANCISCO, CAL.

Ankorflex packings impose minimum friction and result in decreased power consumption and longer packing life.

Ankorflex is a sturdy, self-acting lip packing designed especially for use on hydraulic rods and plungers and against high and low pressures. Also extensively used on outside packed rods, rams and plungers.

This packing, while responding to pressure, at no time distorts under pressure of the liquid.

Rings are cut diagonally. However, if endless rings are desired, please so specify.

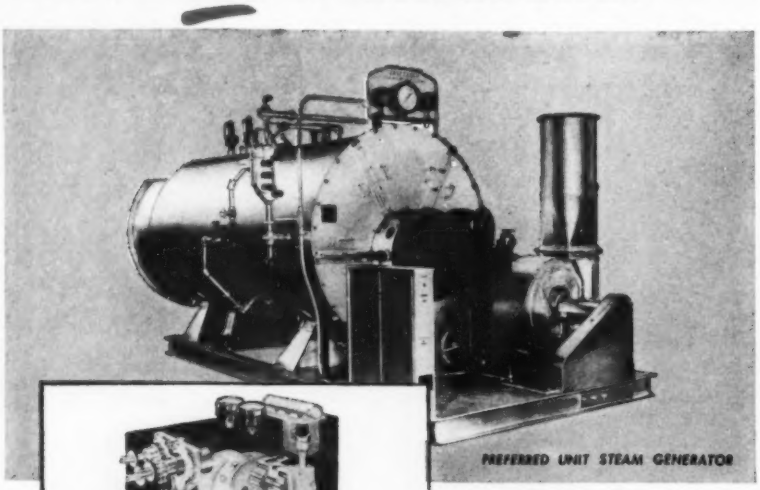
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

there *IS* a difference*



PREFERRED UNIT STEAM GENERATOR

* Voluvalve Fuel Regulator... another 25 year built in Preferred "Quality Feature" that means accurate, *efficient* combustion.

when you're burning BUNKER "C"

Preferred's Unit Steam Generator handles any and *all* the variations of Bunker "C" and No. 6 oil that are coming through these days from catalytic cracking . . . and they do it *better* and *more efficiently* than any other unit steam generator on the market because—

* *No other unit has Preferred's "Voluvalve"* Fuel Regulator! In conjunction with a constant displacement pump the "Voluvalve" — through *positive,* reciprocal proportionate gearing—supplies an exact and accurately metered amount of oil to atomizer or fuel feed system.

* *No other unit has Preferred's High-Speed Atomization* —taking the metered fuel, Preferred's rotary cup speeds at *4600 RPM* and easily atomizes the most viscous oil to a fine spray. Higher air velocities provide for greater collision effect and better atomization and allow complete control of spray angulation for carbon-free operation.

Write or call for complete details of "quality features" described in Bulletin 2000.

PREFERRED UTILITIES MFG. CORP.
1860 BROADWAY • NEW YORK 23, N.Y. 202

More EQUIPMENT NEWS

Begins on page 154

side water supply, provides a steady flow of cooled water at proper operating pressure. Sealed-in water coolant prevents scaling and corrosion.

Warm water is forced through two automobile-type radiators, while a high-capacity blower draws outside air through the radiators. The water is quickly cooled, then returned to the air conditioner in a continuous cycle. Unit weighs 350 lb, occupies 8.3 sq ft of floor space.

Chrysler Corp, Airtemp Div, 341 Massachusetts, Detroit, Mich.

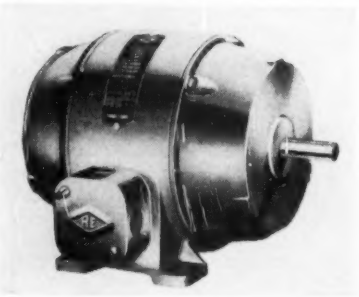
Boiler Level Indicator

343 • This 12 in. dial indicator operates on the differential pressure principle. It can be mounted on a panel or pipe standard, bringing the dial to convenient eye level.

Indicator is available in various standard ranges from 0-20 to 0-200 in. of water. The forged steel body has a rated working pressure of 2000 psi; parts are factory-tested for safety at 4000 psi. Bulletin 392.

Foxboro Co, Foxboro, Mass.

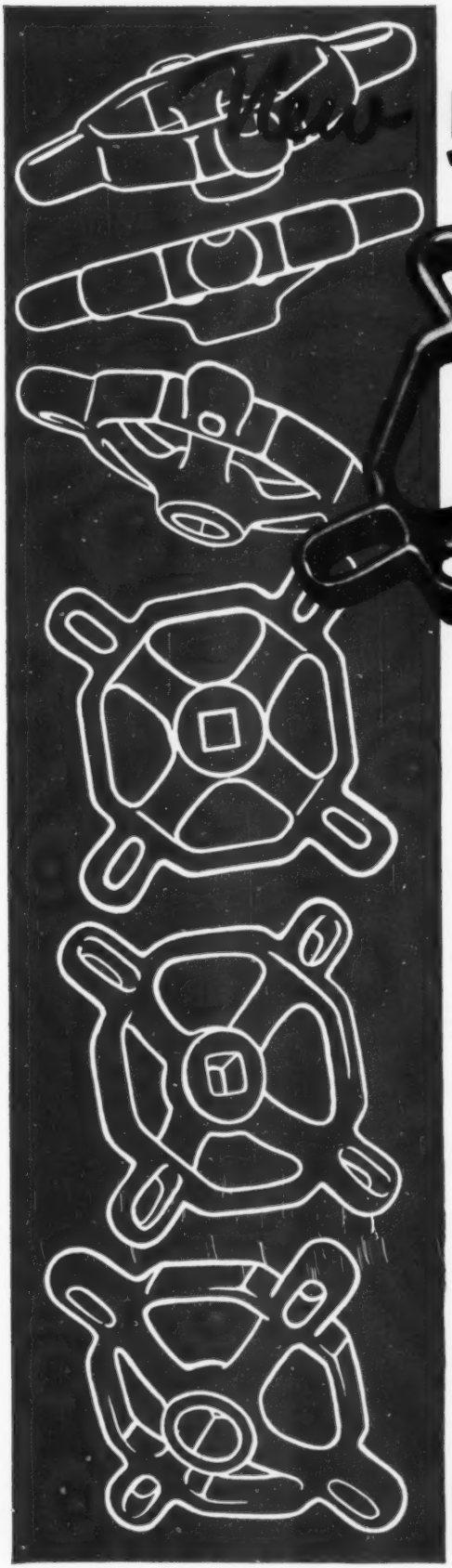
For more data on these items, use post cards p. 163. Identify your request with item number.



Multi-Speed Motors

352 • Motors are available in either 2, 3, or 4-speed ratings, in either constant-torque, variable-torque, or constant horsepower types. Two-speed motors have either one or two windings, 3- and 4-speed motors have two windings. Sizes range from ½ to 150 hp.

Multi-speed motors can be furnished in either standard, totally-enclosed, splash-



LUNKENHEIMER "non-slip" HANDWHEEL

CLOSES VALVES TIGHT!

With this revolutionary new handwheel design, *ordinary hand pressure closes the valve absolutely tight, thus preventing leakage.*

Rounded lugs provide a firm, comfortable, secure grip, even when the operator's hand is wet or greasy. And the "Non-Slip" Handwheel stays cool —does not transmit excessive heat to the outer rim. Operator's hand cannot touch the top of the valve stem, which may be hot.

Only Lunkenheimer Valves have the new malleable iron "Non-Slip" Handwheel. Ask for a demonstration of its amazing performance. Hear how it will save you money by eliminating one of the most common causes of valve leakage.

WRITE FOR new bulletin describing the advanced "Non-Slip" Handwheel and demonstrating its outstanding features. The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL

LUNKENHEIMER

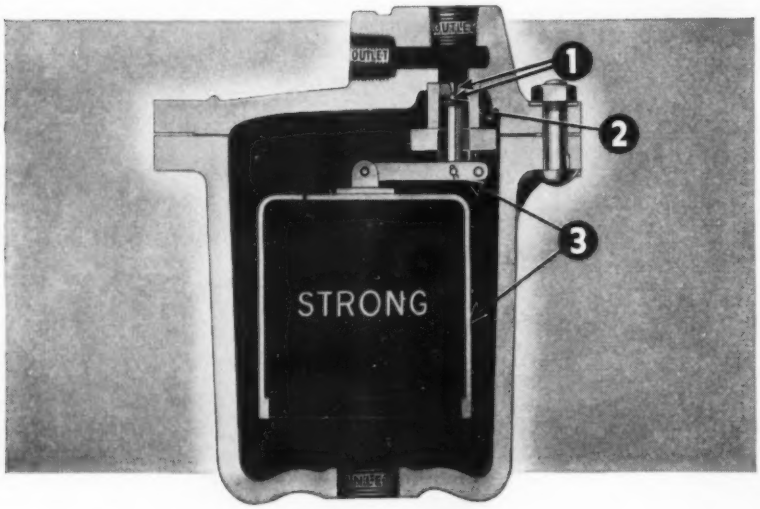
THE ONE *Great* NAME IN VALVES

L-752-S

3 Reasons

STRONG* Traps

are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-H describes inverted, open bucket and other types of STRONG traps. Write today.

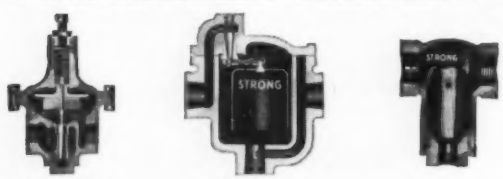
*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



Reducing Valve | 70 Series Trap | Strainer

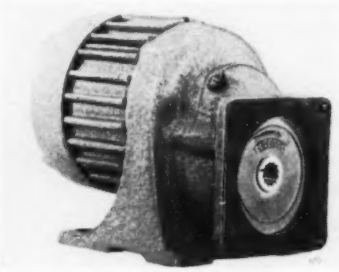
STRONG

More EQUIPMENT NEWS

Begins on page 154

proof or explosion-proof de igns. They are also available as *motoreducers* with magnetic brakes. Folders MS-1000.

Reuland Electric Co, Alhambra, Calif.



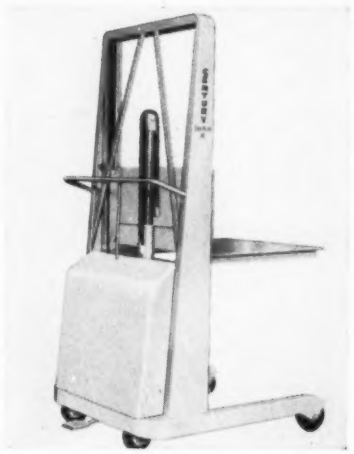
Low-Speed Motor

309 • Low-speed aircraft motors for hazardous locations are rated at 1½ hp continuous duty, 400 cycle, 3-phase ac, have internal gearing and double-enclosed construction.

Features of this unit include: hardened and shaved helical gears, integral fan, heat dissipating fins, pyramidal base to withstand high "G" loads, internal spline take-off shaft, AN mounting pad, thermal overload protection, rapid acceleration and high starting torque.

U.S. Electrical Motors Inc, Aircraft Div, Terminal Annex, (Box 2058), Los Angeles 54, Calif.

For more data on these items, use post cards, p. 163. Identify your request with item number.



Lift Truck

315 • Combination hydraulic-electric lift truck is designed for 1000-lb capacity loads. *Century 1000-E* is manually propelled and will handle light and medium materials handling jobs. Electric lift is actuated by a piston-type hydraulic pump, powered by a 6-v electric motor. Current is supplied by an automotive-type storage battery equipped with a battery charger for overnight charging.

Unit will raise load from floor level to a height of 4 ft in 15 sec. A small lever at the

RED WING, MINNESOTA
A DETROIT STOKER TOWN

Two Hospitals • The High School • A Hotel
Three Industrial Plants • And the Power Company
All Equipped with Detroit Stokers.

14 DETROIT STOKERS (INDUSTRIAL TYPE) IN 7 PLANTS

Red Wing, Minnesota has a very high percentage of Detroit Stokers in comparison to the population of 10,000 people.

Red Wing Burns Coal—the Basic Fuel with Detroit Stokers because they are always dependable, economical.

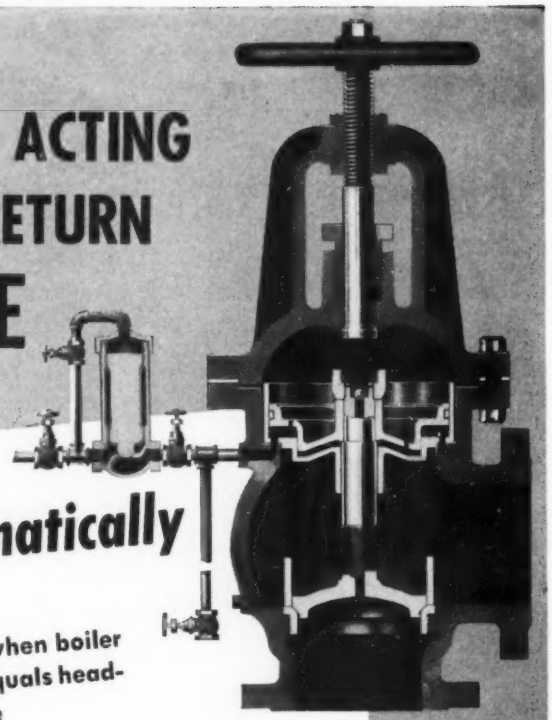
Write for Catalog

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities

This
TRIPLE ACTING
NON-RETURN
VALVE



Automatically

✓ **Opens** when boiler pressure equals header pressure

✓ **Isolates** and prevents back steam flow into a defective or lower steaming boiler

✓ **Prevents** boiler steam flow when steam line or header is ruptured.

GOLDEN-ANDERSON

also makes this Single-Acting Non-Return Valve

which will automatically open to cut-in the boiler when its pressure equals the header pressure and automatically close to isolate the boiler when its pressure decreases.

Bulletins S-1A and S-2 contain complete technical data.

Golden Anderson Valve Specialty Company

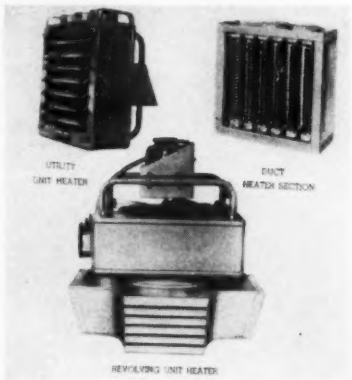
2070 KEENAN BUILDING • PITTSBURGH 22, PA.

More EQUIPMENT NEWS

Begins on page 154

operator's fingertips releases the 23 x 24 in. material platform for controlled descent or stops it at any intermediate position. Overall height is 64 in.; base area is 29 in. wide by 34 in. long.

Century Products Co, Dept KP, 5925 Highway 7, Minneapolis 16, Minn.



Electric Heaters

355 • Unit heaters and heating sections employing *Hynes* electric elements have wide range of sizes. Heaters deliver from 13,600 to 204,000 Btu per hr, sections from 25,500 to 204,000 Btu per hr. Discharges range from 235 to 3600 cfm.

Ceiling-suspended units have either revolving or stationary outlets; horizontal heaters have adjustable vanes. Heating elements can be switched off to use fan for cooling. Heater sections are designed to be applied to a run of duct for process heating.

L J Wing Mfg Co, Linden, N. J.

For more data on these items, use postcards p. 163. Identify your request with item number

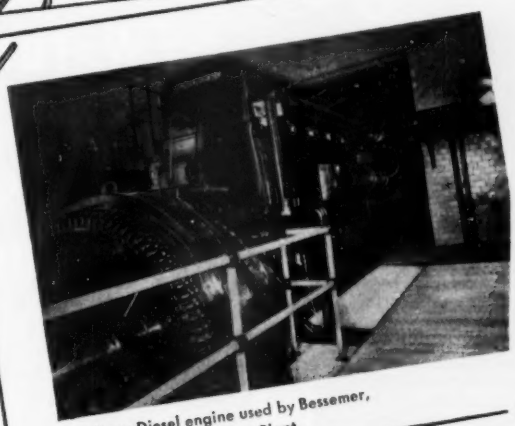
High-Pressure Gage

338 • *Ashcroft Maxisafe Duragage* combines protection to the viewer with easy entree to the entire gage movement and tube assembly for inspection, recalibration or repair.

An integrally cast solid wall separates

*Could you make this report about your diesel engine?**

CITY OF BESSEMER, MICHIGAN REPORTS:



Nordberg Diesel engine used by Bessemer, Michigan Municipal Power Plant.

PISTONS PULLED AT 24,600 HOURS!

- All rings were free
- No carbon in ring grooves
- All original rings replaced in original grooves
- Rings should last at least 10,000 more hours
- Maximum cylinder wear was .004 at top, .002 at bottom

EXCELLENT

OIL CHANGE AT 5000 HOURS!

- No oil added to crankcase between changes
- Power cylinders fed at rate of 5 drops per minute
- Main bearing, rod bearings show very little wear
- Average K.W. per gallon of fuel is 13.5 @ 60% load factor

Sam Kalember

Superintendent,
Bessemer Light Utility.

Note:

FOR TOP ENGINE EFFICIENCY, BESSEMER RELIES ON:

Cities Service DC-930 Oil used for crankcase lubrication!

Cities Service DC-230 Oil used for power cylinder lubrication!

* Why not contact your nearest Cities Service Representative or write Cities Service Oil Company, Dept. C16, Sixty Wall Tower, New York City 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

PANALARM "50" ANNUNCIATOR SYSTEMS

PANALARM "50" PLUG-IN UNIT . . . hermetically sealed and most versatile ever developed . . . simply plugs into chassis to expand system . . . no wiring . . . no other connections. Corrosion-proof and suitable for Class I, Div. 2 locations.

NEW functional flexibility with NEW "instrument-type" construction

Built-in flexibility of PANALARM "50" allows simple change-over to any operating sequence as required by present or future conditions. And, at the same time PANALARM "50" introduces a new instrument-type annunciator construction . . . adding to the long-term dependability of the entire system.

CABINET is substantial gauge steel with sturdy chassis and sub-door arrangement. It is pre-wired ready for installation, yet completely flexible without re-wiring.

PANALARM ANNUNCIATOR SYSTEMS are self-contained with either illuminated name-plates or bullseye visual signals. Both the audible signal and acknowledgment button are common to the entire system.

SEND FOR COMPLETE 40-PAGE MANUAL

Ask for Catalog 100-1

PANALARM

PANALARM PRODUCTS, INC.
6312 North Broadway, Chicago 40, Illinois

Copyright 1953 Panalarm Products, Inc.

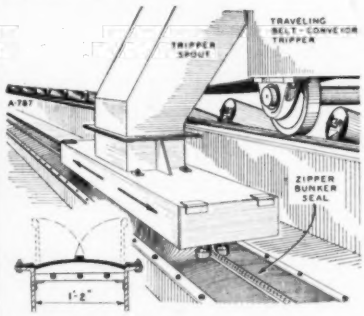
More EQUIPMENT NEWS

Begins on page 154

dial from the gage movement and tube. Double spring-mounted safety release plate covers the entire back of the case. Plate permits discharge of the pressure media away from the viewer. Safety release plate is teflon coated, fits tightly on a rubber gasket and is held in place by a small knurled knob. Less than ½ psi forces open the safety release plate.

Pressure ranges include 15 psi or vacuum minimum to 100,000 psi maximum. Compound and retard ranges also are available. Sizes include 4½, 6 and 8½ in.

Manning, Maxwell & Moore, Inc, Stratford, Conn.

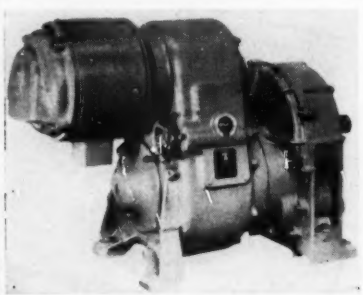


Zipper Bunker Seal

346 • Bunker seal consists of two zipper-toothed seal belt strips and an opening and closing mechanism. The reversible belt-operating mechanism hangs from the tripper spout, with rollers at each end spreading the teeth for easy opening or closing, depending on direction of travel. Rollers mounted on pantograph frame maintain proper belt contact at all times. Belt is open only directly under discharge point, so dust cannot escape. Metal shield on tripper chute completes the seal. Bulletin 952.

Stephens-Adamson Mfg Co, Aurora, Ill.

For more data on these items, use post cards p. 163. Identify your request with item number.



Variable Speed Drive

314 • New type KFEB double reduction 20 and 25 hp *Speed-Trols* have speed variation of 2:1, 3:1 and 4:1, provide infinite variable speed in the low speed ranges. The 20-hp type 364 KFEB is available with maximum speeds from 176 to 42 rpm and the 25 hp type 365 KFEB with maximum

LADISH

Controlled Quality

PIPE FITTINGS

offer dependability safeguarded by advanced metallurgy

Year after year... in all kinds of service... Ladish Controlled Quality Fittings set new standards of reliability. One reason is the strong reliance on technical progress. Every new facility and advanced technique of modern metallurgy is fully utilized to develop desirable physical properties to maximum limits... while unrelenting test procedures continuously safeguard metallurgical soundness and provide users with authentic data proving the complete dependability of every Ladish Fitting.

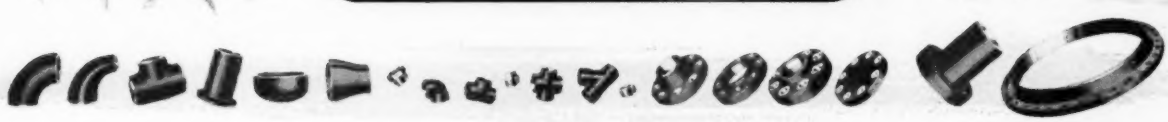
TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

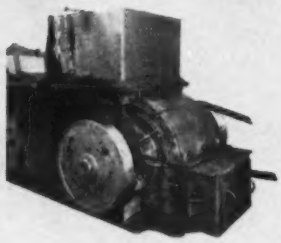
LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

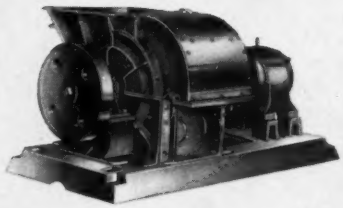
District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



FOR HIGH TONNAGE CRUSHING . . .

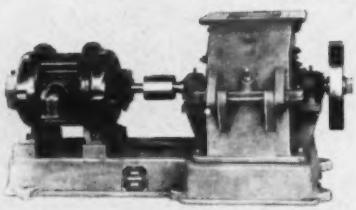


Heavy Duty 30-S. For Primary Crushing. Crushes ROM coal, rock, slate, sulphur balls and gob—high tonnage without oversize. Saves labor costs of pickers.

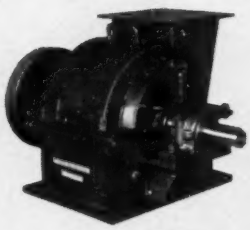


"S" Series. 9 sizes. Capacities up to 500 TPH. High tonnage with minimum fines. Well suited to power plants.

OR COAL SAMPLING . . .

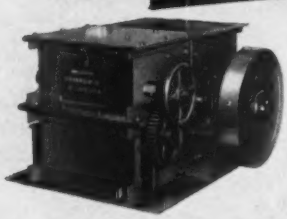


Laboratory Mill. 2 sizes. Capacities up to 2000 lbs./hr. Very efficient for coal sampling.

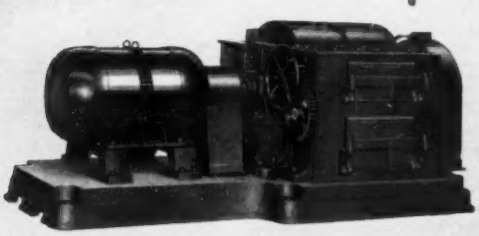


"13" Series. Three sizes. Capacity up to 6 TPH. For experimental runs, testing, and pilot plant operations.

THERE'S AN *American* ROLLING RING CRUSHER . . . FOR YOUR OPERATION!



"WC" Series. 4 sizes. Capacities up to 90 TPH. Available with drop cage. Compact, requires minimum headroom.



"AC" Series. 17 sizes. Capacities up to 800 TPH. Dual adjustability for easy size control. Drop cage for easy cleanout.

WRITE for details today. Describe your crushing needs.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave.
St. Louis 10, Mo.

ALL FORGED STEEL

Edward
CHECK VALVES

for freedom from vibration, clatter and piping shock

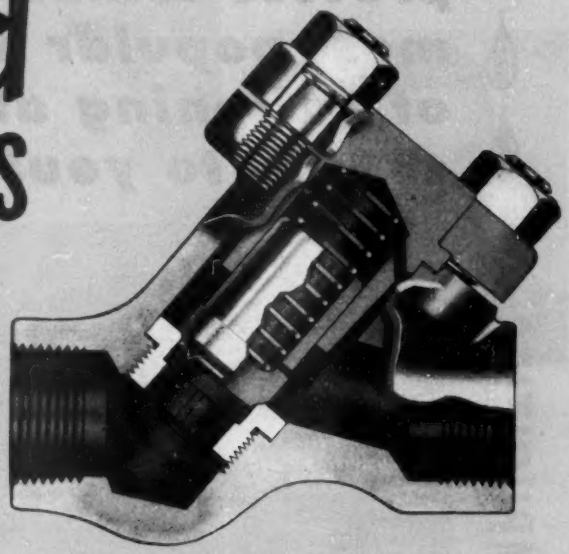


FIG. 4638,5538

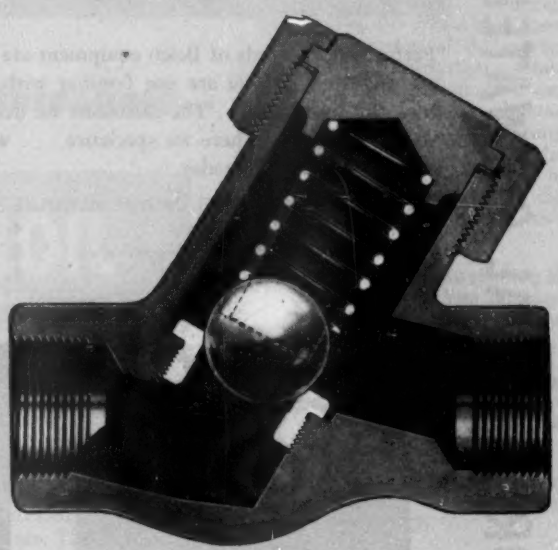


FIG. 2672,3572

For all piping systems requiring small check valves, Edward furnishes a complete line of forged steel valves in both principal check valve types:

PISTON TYPE CHECK VALVES for extra advantage in lines where it is important that the disk closes tightly upon the seat. Careful design of internal parts gives full flow area, low head loss, avoids excessive shock. Exclusive disk guide lip and spring loading for quick positive seating. Available with stellite contact faces on seat and disk on special order.

BALL CHECK VALVES are ideal where heavy viscous fluids are encountered. Bodies are of specially heat treated forged steel. The stainless steel ball of special EValloy high chromium stainless steel is guided by two steel ribs. A spring aids in seating the ball on the carefully lapped seat.

AVAILABLE IN WIDE RANGE OF SIZES AND STYLES

- √ 600, 1500 and 2500 lb sp pressure classes
- √ Horizontal or vertical types
- √ Screwed, flanged or socket welding ends
- √ Union, bolted or welded bonnet
- √ Ball or piston type disk
- √ In ¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2" sizes

GET ALL THESE PLUS FEATURES:

- √ Extra strong and long spring of stainless steel for sure closing action
- √ Rated for 600 lb sp at 850F, 1500 lb sp at 850F and 2500 lb sp at 1000F
- √ Extra strong bodies of specially heat treated forged steel
- √ Cushioned closing action eliminates excessive vibration
- √ Fit any piping arrangement, vertical or horizontal
- √ Corrosion proof stainless steel seats and disks or balls
- √ Accessible removable seats
- √ Easy disassembly if needed
- √ Streamlined body contours for free flow, low pressure drop

In addition to forged steel check valves, Edward builds a complete line of larger cast steel check valves—there is an Edward valve for every check valve application. Write for complete information.

Edward Valves, Inc.

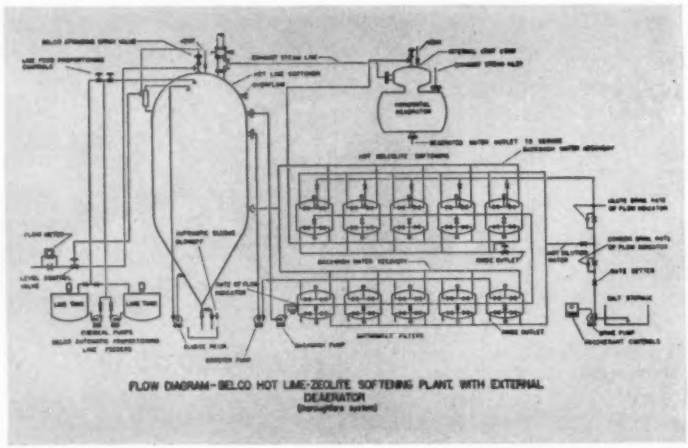
Subsidiary of ROCKWELL MANUFACTURING COMPANY

1220 W. 144th St. • East Chicago, Indiana

Another Product

PROCESSES FOR REMOVAL OF WATER IMPURITIES

The Hot BELCOLITE process combines two most popular methods of softening at a saving to you!



FLOW DIAGRAM—BELCO HOT LIME-ZEOLITE SOFTENING PLANT WITH EXTERNAL DEAERATOR

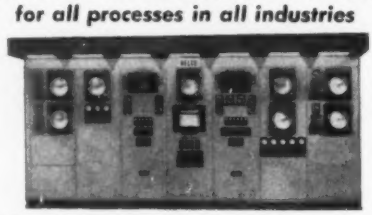
Performance records of Belco equipment are recognized throughout industry. If you are not familiar with the facts we would like to inform you . . . The customers we design and build for — the types of jobs where we specialize . . . we know you will be interested. Call us, today.

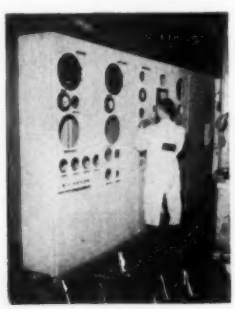
ADVANTAGES OF HOT BELCOLITE PROCESS.

1. Zero Hardness in effluent
2. Lowest cost method of silica reduction
3. Lower alkalinity
4. Requires less attention
5. Less skilled personnel
6. Saves chemicals
7. Reduces capital investment

Automatic Control Panels

for all processes in all industries





Belco specializes in automatic panel design and manufacture. Belco automatic panels control the world's largest silica removal demineralizing plant. They can control your process automatically, too.

Ask the Belco man!

We invite your consultation regarding all water condition requirements. Get acquainted with our friendly organization for authoritative assistance and close cooperation. Write for late descriptive bulletins.

Belco

Belco Industrial Equipment Division, Inc.

PATERSON 3, NEW JERSEY

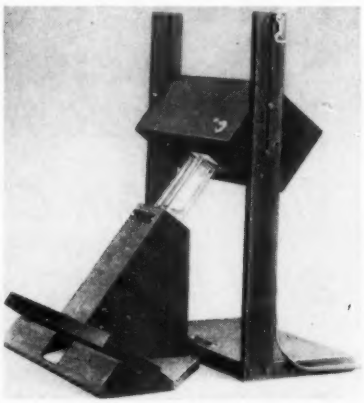
OUR REPRESENTATIVES LISTED IN THOMAS REGISTER

More EQUIPMENT NEWS

Begins on page 154

speeds from 176 to 64 rpm. Variable pitch pulleys provide efficient power transmission. Drip-proof and splash-proof models feature direct-through ventilation system. The totally enclosed, fan-cooled model has a dual cooling system for internal and external cooling.

Sterling Electric Motors, Inc, 5401 Anaheim-Telegraph Road, Los Angeles 22, Calif.



Water Analyzer Accessory

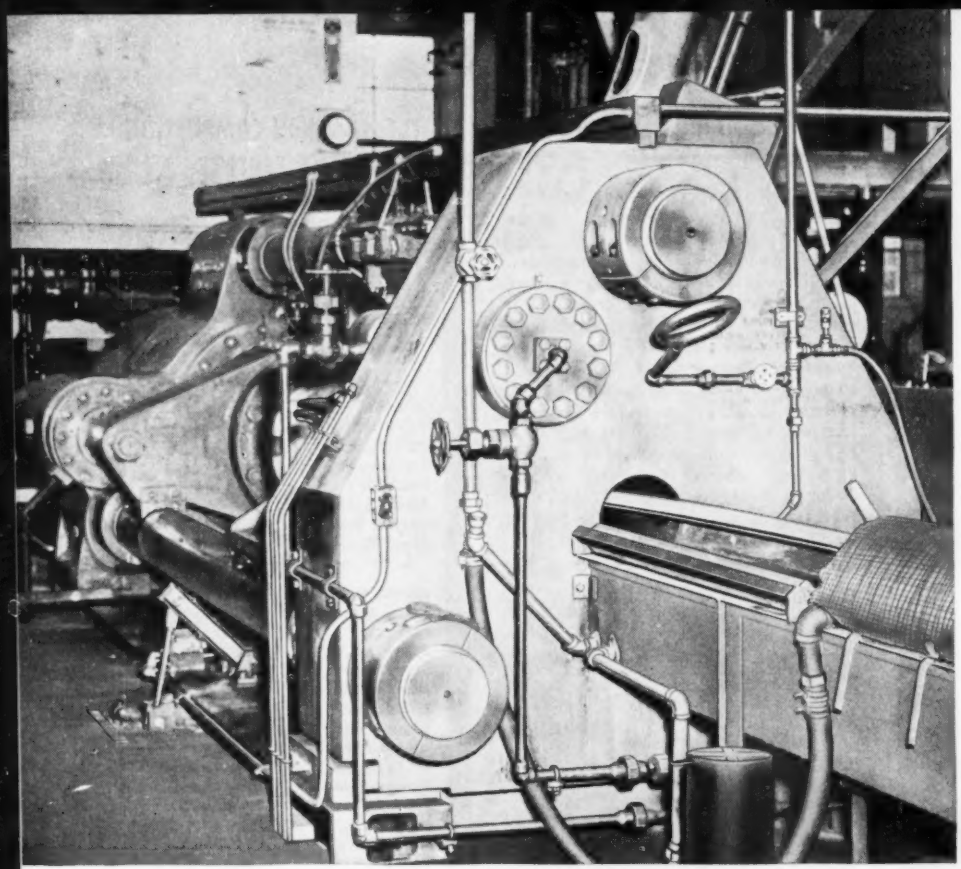
P362 • Water analyzer lamp gives uniform daylight conditions, suited for use when water analyses must be made at night or in poorly lighted areas. Measuring 15¾x9¼x5⅞ in., it is fitted with a special daylight glass filter and bulb and operates on any type 110 v current. Fully adjustable lamp can be used with either long or short water analyzer tubes.

W A Taylor & Co, 7307 York Rd, Baltimore, Md.

For more data on these items, use post cards p. 163. Identify your request with item number.

Industrial Television

316 • Portable lightweight, completely self-contained closed circuit television "station" is 14 x 9⅜ x 4⅝ in. Unit is designed for remote control, inspection, check-



Puts squeeze on hydraulic press maintenance...

● Shown above is the 1250-ton hydraulic press used by the Light Metals Corporation of Grand Rapids, Michigan, for extruding variously shaped sections of aluminum. When this press was installed recently, officials gave the important hydraulic oil job to STANOIL Industrial Oil. They based that decision on their own experience with this outstanding oil.

That experience covered over four years' use of STANOIL in the hydraulic system of a 315-ton extrusion press. STANOIL has served continuously in this press without being changed or removed for oil maintenance. The hydraulic oil system has never been cleaned and has remained entirely free from deposits and varnish. Hydraulic operation has been efficient at all times.

The experience of the Light Metals Corporation is your assurance of STANOIL's ability to reduce hydraulic system maintenance to a minimum in your plant. This versatile oil will provide clean, dependable lubrication for such a variety of equipment as air compressors, reduction gears, and electric motors. The Standard Oil lubrication specialists will help you make the most effective use of STANOIL. Phone him at your local Standard Oil (Indiana) office. Or write, Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Ill.

STANOIL
TRADE MARK
Industrial Oil

What's YOUR problem?

D. R. Clay, of Standard Oil's Grand Rapids, Michigan, office, is the lubrication specialist who has helped Light Metals Corporation keep maintenance of hydraulic units at a minimum through use of STANOIL Industrial Oil.

He is one of many Standard Oil specialists located throughout the Midwest. These men have the practical experience and special training to handle lubrication problems on any type of operation.

Take advantage of the service offered by the lubrication specialist nearest your plant. You can contact him easily by phoning your local Standard Oil Company (Indiana) office. With his help, find how many different oils in your plant can be replaced by STANOIL Industrial Oil on such applications as:

Air compressors . . . no sticking or clogging of valves, less oil consumption in splash or circulating systems.

Speed reducers . . . less wear of gears and bearings during frequent cold starts or prolonged high-temperature operation.

Steam turbines . . . freedom from emulsions and sludge, fewer oil changes necessary.

Ring-oiled bearings... rings function immediately on starting, less bearing wear.

Circulating and bath systems . . . one oil for a wide variety of jobs.

STANDARD OIL COMPANY **STANDARD** *(Indiana)*

floor gratings

with Bordens

free planning

and checking

service

write for
free catalog

BORDEN

BORDEN METAL PRODUCTS CO.

Green Lane, Elizabeth, N. J. P-3

Gentlemen:

Please send me Borden Catalog No. AT-253.

name.....

co. name.....

st. and no.....

city, state.....

See our Catalog in Sweets

More EQUIPMENT NEWS

Begins on page 154

ing, multiple viewing etc, applications.

Camera utilizes any standard television receiver, with no alterations. All camera controls are easily accessible at the camera. Installation can be made with a simple cable connection between camera and receiver, each connected to a standard power source. No highly trained personnel are required—remote control of the camera is simple on-off and channel switching at the receiver. A single camera can televise to just one, or simultaneously to several, receivers; conversely, one receiver can pick up several cameras by simple channel switching at the receiver.

Dage Electronics Corp, 69 N 2nd St, Beech Grove, Ind.

Emergency Lighting Unit

302 • In case of power failure this unit will provide maximum sufficient illumination to carry on operations. Light instantly illuminates the room if regular power fails.

Unit is powered by a storage battery built into the portable set. Trickle charger automatically maintains the charge of the battery. Built-in hydrometer indicates the state of the battery at a glance. Unit simply plugs into any ac circuit. The lights are sealed beam of 100 candle power and will provide 10 hours of light.

General Scientific Equipment Co, 2700 W Huntingdon St, Philadelphia 32, Pa.

For more data on these items, use post cards p. 163. Identify your request with item number.

Glass Fiber Insulation

349 • *Ultrafine* insulation is lightweight, fire resistant, will not rot, mold or decay. It is resilient, resists vibration, will not pick up odors. It is not corrosive to metals, resists attack of most acids and alkalis, and is permanent, according to the manufacturer.

Available in rolls, either plain or faced with any one of 5 different vapor barriers, or die-cut to any shape. Standard roll widths are 18, 24, 36 and 48 in., thicknesses range from ½ to 1½ in. *Ultrafine* can be cut with an ordinary knife or shears, and

These leading COMBUSTION EQUIPMENT EXPERTS supply and service

fireye

AREA OFFICES of Combustion Control Corp.

*ATLANTA, GA. Walnut 3658
*BOSTON, MASS. Commonwealth 6-7585
*CHICAGO, ILL. Reliance 5-6030
*DALLAS, TEX. Dixon 3072
*NEW YORK, N. Y. Hanover 2-4737
*PHILADELPHIA, PA. Locust 7-5922
*SAN FRANCISCO, CAL. Exbrook 2-8700
*WASHINGTON, D. C. Columbia 3322

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CHARLESTON, W. VA. G. H. Zimmerman Co. Charleston 22-212
CHARLOTTE, N. C. James L. Highsmith & Co. Charlotte 5-6436
CINCINNATI, O. Richard Equipment Co. Cherry 3240
*CLEVELAND, O. Slawson Equipment Co. Express 1-7263
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DETROIT, MICH. D. T. Randall & Co. Woodward 2-4267
*HOUSTON, TEX. Industrial Equipment Co. Woodcrest 2693
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LOUISVILLE, KY. Richard Equipment Co. Wabash 3235
MILWAUKEE, WIS. V. P. Hansen Co. Daily 8-2338
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*MONTREAL, QUE. Martin Engineering, Inc. Wilbank 4185
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PITTSBURGH, PA. Russell F. Clark Co. Atlantic 1-8089
PORTLAND, ME. Crosby & Siegars, Inc. Portland 3-2067
PORTLAND, ORE. W. R. Norte Co. Tuxedo 3459
RICHMOND, VA. Carroll G. Traylor Co. Richmond 6-2337
ROANOKE, VA. Carroll G. Traylor Co. Roanoke 2-6548
ROCHESTER, N. Y. Niagara Electric Sales Co. Hamilton 5168
ST. LOUIS, MO. Hester-Bradley Co. Franklin 3406
SALT LAKE CITY, UT. Leonard M. Slusser Salt Lake City 5-2322
SAN FRANCISCO, CAL. Continental Control Co. Sutter 1-4464
*SEATTLE, WASH. R. H. Liniger Co. Alder 2305
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TAMPA, FLA. Industrial Specialties Sales Tampa 8-1237
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*TULSA, OKLA. Snyder Co., Inc. Tulsa 4-0126
VANCOUVER, B. C. Pacific Controls Co. Tatlow 1228
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In service, too IT'S FIREYE COAST to COAST

Factory-trained field engineers the country over provide the best on-the-spot "know-how" of industrial flame failure safeguarding . . . with Fireye

● Install Fireye Flame Failure Safeguards anywhere in the country — on industrial oil, gas or pulverized coal burners — and Fireye's national organization of factory-trained and field-experienced engineers is ready to serve you.

● Your local Fireye expert offers you overall knowledge of detecting with Firetron and controlling with Fireye the flame failure hazards that are present when you burn all industrial fuels. He will assume undivided responsibility for supplying suggested specifications, as well as a complete wiring diagram integrating all associated operating controls and fuel shutoff valves. Furthermore, he will assure trouble-free performance by training and supervising installation personnel.

● Call your nearest Fireye office now for a demonstration of his services—and of Fireye, America's accepted flame failure safeguard standard for industry.

fireye

COMBUSTION CONTROL CORP.

Dept. PB 3, 720 Beacon St. Boston, Mass.

is

coil-itis* increasing your temperature problem?

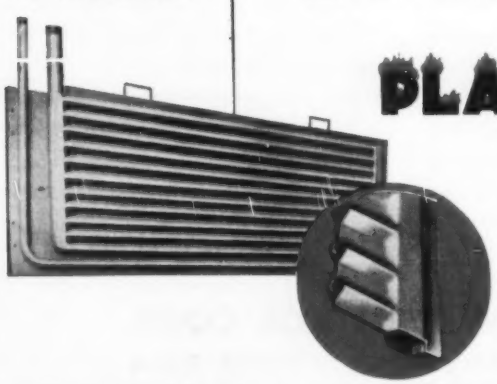
Here is a new treatment for solving your heat transfer problems that is as revolutionary as a new wonder drug. It stops coil-itis* cold . . . It eliminates the many troubles that have plagued industrial heating and cooling practices due to the use of old-fashioned, outmoded pipe coils. This revolutionary new unit, called a Platecoil, heats or cools 50% faster and takes 50% less space in the tank. It simplifies maintenance and saves hours of downtime.

Write for bulletin P79 today!

PLATECOILS SAVE 50% IN HEAT TRANSFER COSTS

PLATECOILS COOL QUENCH OIL TANK FOR ⅓ THE COST

At the K-D Manufacturing Company, Platecoils are proving more efficient, yet cost only 1/3 as much to install. Ask about other case histories.



PLATECOIL

REPLACES PIPE COILS

Coil-itis — Diagnosed as tank heating and cooling problems. Platecoils — the prescription for solving pipe coil problems.

PLATECOIL DIVISION, KOLD-HOLD MANUFACTURING CO., LANSING 4, MICHIGAN

More EQUIPMENT NEWS

Begins on page 154

can be applied to all types of heated and cooled equipment to 450 F.
Gustin-Bacon Mfg Co, 1416 W 12th St, Kansas City, Mo.

Slide Rule Magnifier

363 • Double magnifier for duplex slide rules permits accurate readings on both sides of the rule simultaneously. It consists of two lenses, folds to fit compactly into scratch-preventative chamois bag. Version for pocket-sized rules has magnifying power of 3 times, units for other sizes magnify 2½ times.
Flatto Management Co, 70 W 40th St, New York 36, N.Y.

Rosin Core Solder

364 • *Divco* X-25 ro in core solder provides flux activity before solder is completely molten, so solder takes to the base metal immediately. Non-corrosive and high dielectric properties said to equal pure ro-in flux, and to conform to all armed forces and federal specifications. Also available as liquid rosin flux.
Division Lead Co, 836 W Kinzie St, Chicago 22, Ill.

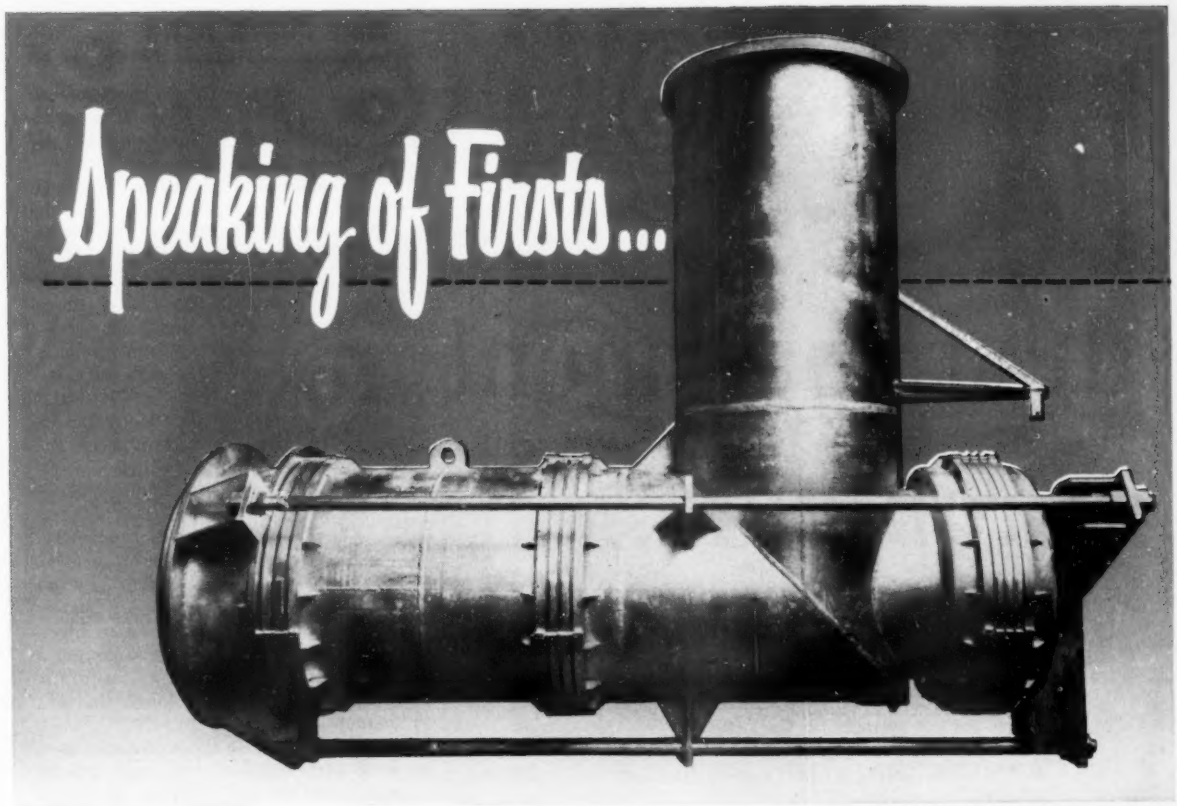
For more data on these items, use post cards p. 163. Identify your request with item number.

Load Interrupter

324 • New metal - enclosed *dis - ruptor* switch for 600-v ac or dc service combines the functions of disconnect and load interrupter. Switch can withstand severe usage. With its arc-ruptor chamber and quick-make, quick-break mechanism, it offers safe, positive load interruption.

Available in ratings of 400, 600, 1200, 2000 and 3000 amps, two-pole or three-pole units with or without provisions for *Amp-trap* fuses. Publication 5208.
Delta-Star Electric Div, H K Porter Co, Inc, 2437 Fulton St, Chicago 12, Ill.

Speaking of Firsts...



Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

This example is representative of our ability to cope with the most difficult expansion joint problems. It is our business to specialize in the design and manufacture of one product only—expansion joints—and over the years we have learned how to solve the "tough ones" effectively and quickly.

Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

The next time you are faced with an expansion problem, get in touch with us. We will be glad to survey your situation and recommend the most practical and economical solution. Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

Your Management wants to know...

How to solve the dust abatement problem ... economically

PLANT ENGINEERS, working with Buell engineers, have proven again and again that their know-how coupled with Buell's long experience in Dust Collection can solve your Fly Ash problems more economically, more efficiently.

What's more, Buell Dust Collection Systems offer all American industry these further advantages: smoother plant-community relations, improved product quality and higher employee morale.

Buell's knowledge and experience in the highly specialized science of Dust Collection are yours. To learn more about Buell's **3 basic systems** of Dust Collection and how they can help you, send for the new, informative booklet titled, "The Collection and Recovery of Industrial Dusts." Buell Engineering Company, Dept. 50-C, 70 Pine Street, New York 5, New York.

Van Tongeren Cyclone | 'SF' Electric Precipitator | Precipitator-Cyclone Combination | Type 'LR' Collector | Dust Hopper Valves

ELECTRIC CYCLONIC

buell

ENGINEERED EFFICIENCY IN DUST COLLECTION

More POWER NEWS

Begins on page 148

tional thousands needed as teachers. Yet prospects of new engineering graduates over the next four years will not fill the widening gap.

To help bolster the ranks, the Engineering Manpower Commission of the Engineers' Joint Council last spring asked the Advertising Council, a nonprofit public service advertising organization supported by American business, to conduct an advertising campaign on behalf of the nation's engineering deficit.

Now rolling into high gear, the Council's program encourages qualified high school students to think about engineering as a career by showing them and their parents the opportunities that exist in engineering both today and in the future.

It has prepared a 7x10 in. advertisement for business and trade papers, offering a free booklet entitled *How Your Company Can Promote Engineering as a Career.* It has issued an advertisement to house magazines offering a booklet called *Engineering as a Career,* aimed at high school students, parents and teachers.

One-minute spot announcements have been prepared for radio, and articles and editorials are available for use in local newspapers, house organs and school papers. Advertising space or time for this campaign is contributed free by the media used or an advertiser.

For either of these booklets and info on how you can help, write to the Engineering Manpower Commission, 29 West 39th St, New York 18, N.Y.

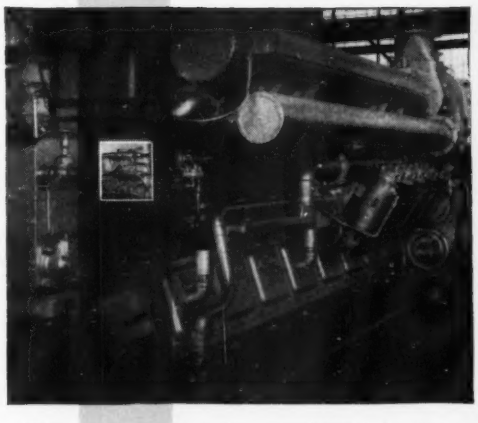
Nominations Due for ASME Gold Medal Award

The American Society of Mechanical Engineers announces the *ASME George Westinghouse Gold Medal Award,* a gift from the Westinghouse Educational Foundation. It is bestowed for "eminent achievement or distinguished service in the power field of mechanical engineering." Nominations for this award should be received at the Secretary's office by March 23, 1953.

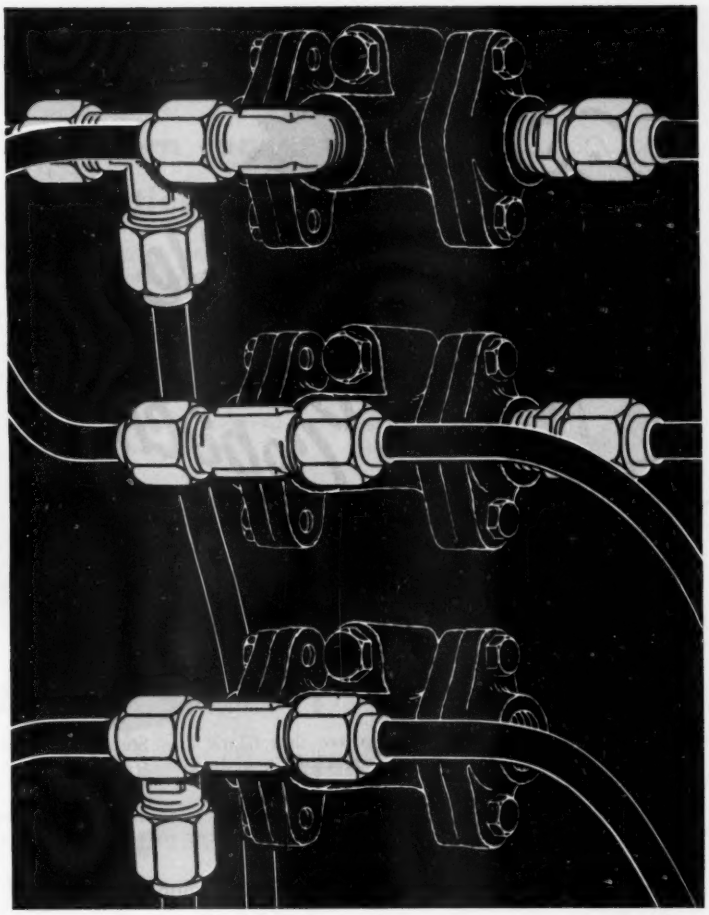
The scope includes contributions of utilization, application, design, development, research, and the organization and administration of such activities in the power field. The word "power" is used in a broad sense. Candidates may be of any age. They do not have to be engineers, members of ASME, or of any other organization.

Nominations should be addressed to the Secretary and should include: (1) Full statement of training, experience, notable contributions of nominee; (2) Basic reasons for submitting nomination; (3) Names of references for fur-

ON DIESEL ENGINES



This typical Diesel engine manufactured by The National Supply Company, Engine Division, Springfield, is equipped with Parker Triple-lok Fittings.



Tube it up...Forget it...WITH PARKER

TROUBLE-FREE TRIPLE-LOK FITTINGS

Diesel service is rugged. Constant vibration puts a severe strain on all engine parts, including fittings connecting fluid handling lines. Yet no leak, however small, can be tolerated.

That's why so many Diesel engine manufacturers rely on Parker Triple-lok Fittings . . . the fitting that meets specifications of the A.S.M.E. Code for Pressure Piping, and J.I.C. and S.A.E. standards. They are leakproof under severest conditions of vibration, elevated temperatures, high pressures and repeated assembly.

So *tube it up* and *forget it* . . . with Parker Triple-lok Fittings. Ask your Parker Distributor for Tube Fitting Catalog 4300, or write The PARKER Appliance Company, 17325 Euclid Ave., Cleveland 12, O.

This does it

Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

Precision Mark of

Leakproof Tube Fittings

Parker

TUBE FITTINGS • VALVES • O-RINGS

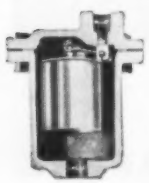
Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

Double Drainage Capacity with Clark DUO-STEP Traps

Engineers know that the effective drainage of condensate from steam lines is a matter of trap capacity. How much condensate can a steam trap of a given size drain in a specific time? The more it can drain the more efficient the trap.

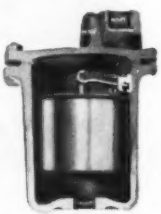
Many tests over a period of years prove that Clark Duo-Step Steam Traps, using the patented double fulcrum principle, can drain *twice* the condensate of ordinary traps.

So why not give Clark Duo-Step Traps a trial on your steam lines and discover for yourself their money-saving features. Phone, write or wire for information.



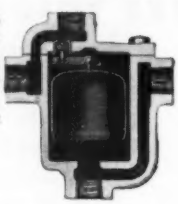
CLARK "701"-D (DUO-STEP) TRAP. A forged steel trap for pressures up to 500 P.S.I. and temperatures of 750°F. Equipped with "double-drainage" Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes ½" or ¾".

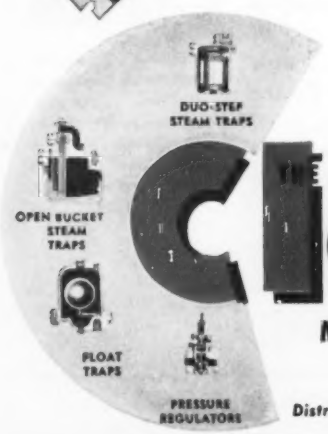
SERIES "80"-D (DUO-STEP) TRAPS. Cast semi-steel construction for pressures up to 250 P.S.I. and temperatures to 450°F. Equipped with Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes from ½" to 2".



"Y" SELF-CLEANING STRAINERS. Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S.

SERIES "60" INVERTED BUCKET TRAP. Choice of horizontal or vertical inlet or outlet. For pressures up to 150 P.S.I. "Clark-loy" guided disc and seat.





THE HOME OF DUO-STEP LEVERAGE

Clark

MANUFACTURING COMPANY

1830 EAST 38th STREET

CLEVELAND 14, OHIO

Distributors and Representatives in all major cities

More POWER NEWS

Begins on page 148

ther information; (4) Statement of nominee's title and company affiliation. or address if retired; (5) Such other information and reference as may assist consideration by the Board of Honors.

Include also a citation, or brief statement usually not over 50 words, which summarizes the nominee's contribution.

Harry Spring Opens Consulting Office

Harry M. Spring Jr, familiar to POWER readers for his many technical articles, has opened a consulting practice at 280 Pleasant St, Canton, Mass. Long known as an authority on boiler construction and operation, he will specialize in design, analysis, radiography, metallography and special operating problems in the power field. Mr. Spring is author of *Boiler Operator's Guide* and *Pressure Vessels for Industry*.

Detroit Edison Celebrates 50th Birthday

From its very beginnings in January 1903 to the present time Detroit Edison Co has distinguished itself as a progressive force in the public utility industry. Many of its achievements have produced lasting benefits to the power field in general.

Some ten years after its founding Detroit Edison established the first research dept within a public utility structure. That dept, now known as the Engineering Laboratory and Research Dept, has a long record of trail-blazing in the high pressure high temperature steam studies field. Notable among these accomplishments are many notable underfeed stoker experiments, a long run of pulverized fuel recommendations, including suggested ways of using fly-ash.

In addition the company has actively investigated new fuel sources. It is in the vanguard in harnessing nuclear energy to the power plant, this issue, p 148.

Along with the steam and fuels side of the picture Detroit Edison can present an equally impressive slate of electric transmission feats such as the 120,000 v "pipe type" underground cable.

Combustion Conferences for Power Engineers

Bituminous Coal Research, Inc, the national research agency of the bituminous coal industry, announced today that it will assist in arranging combustion conferences for groups of power

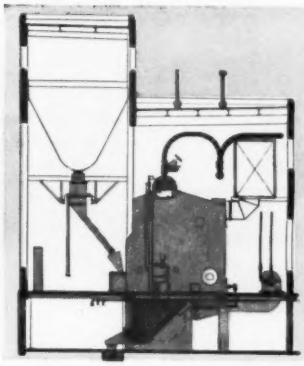
"74.2% MORE STEAM PER DOLLAR—

that's what this modern coal installation gives us at Perfection Stove Co.!"

says George I. Chittenden, consulting engineer for the Perfection Stove Company.

Perfection's old installation, if operating today, would generate 1,362 lbs. of steam per hour per dollar. The new plant produces 2,373 lbs. of steam per hour per dollar. Here's proof of the economy and efficiency of bituminous coal burned with modern equipment.

This view of Perfection Stove's new steam plant shows the coal elevator and ash silo. Coal is delivered through an under-track hopper, lifted by elevator to storage. A pneumatic system carries ashes to the silo.



This sectional drawing of the plant's boiler installation shows the coal bunker over the firing aisle. A weigh larry with dust-proof connection feeds coal to the stokers. The plant is clean and efficient—typical of the modern design that makes full use of coal's inherent advantages.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

● More and more consulting engineers are advising their clients that *bituminous* coal is the best buy for steam fuel. *Here's why:* Nearly everywhere coal yields more BTU's per dollar . . . modern combustion installations step up this inherent economy . . . up-to-date coal- and ash-handling systems cut labor costs to a minimum.

Tremendous reserves give coal a future dependability of supply no other fuel can offer. And to mine this coal, America has the world's most productive and efficient coal industry—making coal the one fuel most likely to remain reasonably stable in price.

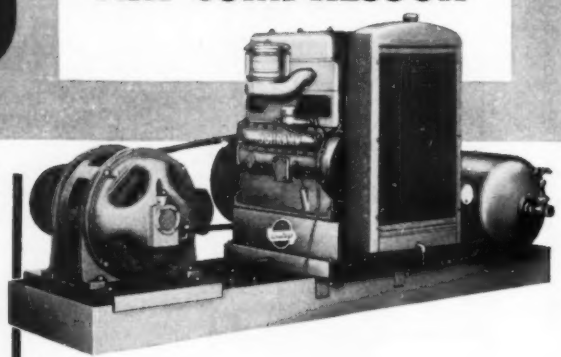
If you're building or planning to modernize a steam plant, call in a competent consulting engineer. He'll show you how a modern coal installation can save you money and do a more efficient job, too!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

FOR HIGH EFFICIENCY ★ FOR LOW COST

YOU CAN COUNT ON COAL!

8 reasons why you save $$$$ when you buy a SCHRAMM AIR COMPRESSOR



"V" Belt Drive With Motor, Cooling Unit And Horizontal Air Receiver

COMPLETE PACKAGE Easy to install and capable of furnishing 24 hour continuous service.

COMPACT Occupies only a fraction of the space required by other makes and designs of compressors.

UNIT SYSTEM You can install several Schramm Compressors, as your needs require, in a minimum of space.

EASY TO MOVE When your plant layout changes or you need an air compressor in another building.

ONE COST No expensive foundation necessary. Just install directly on any substantial floor.

VIBRATIONLESS Perfect balance of pistons and connection rods and vertical in-line construction, makes for vibrationless operation.

LOW MAINTENANCE Proper operating speeds . . . less horsepower required by compressor, cam operated mechanical intake valves provide greater volumetric efficiency.

LOW INITIAL COST Built in sizes ranging from ½ to 100 horsepower. Schramm ratings are given in actual air delivery at 100 p.s.i.g. and not piston displacement.

Write for a free copy of Schramm Catalog 51 10A for information on the complete line of Schramm industrial compressors and accessories.

SCHRAMM, INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

More POWER NEWS

Begins on page 148

engineers, plant engineers, consulting engineers, and others in important coal-consuming markets.

Speakers are being made available and talks, slides, and explanatory models have been prepared on several subjects. The first subject deals primarily with smoke problems caused by deficiencies in overfire air and turbulence in industrial and commercial boiler furnaces. Because of the wide interest in cleaner air, coal consumers will be shown how solid fuel can be used efficiently and within city smoke ordinances.

Subjects in the combustion conference series will also cover other problems relating to combustion, such as coal and ash handling, combustion control, fly ash collection, and good engineering for coal-burning plants.

The meetings, conducted by outstanding engineers of the coal industry, can be sponsored by local organizations such as National Association of Power Engineers, Coal Heating Service, Chambers of Commerce, and others. Groups interested in arranging a series of combustion conferences in their area are invited to contact the co-ordinator of this program, Charles H Marks, Bituminous Coal Research, Inc, 488 West Sixth Ave, Columbus 1, Ohio.

Catalyst Makes Heat from Wastes

A waste-burning catalyst which attracted national attention last spring by running an Allentown, Pa., plant on its own smells, has now been applied in the oil refining industry to make steam and electricity.

Ultimately expected to save American industry hundreds of millions a year in salvaged wastes and to eliminate air pollution at the same time, the catalyst has been pronounced a success by the Sun Oil Company.

Waste carbon monoxide and hydrocarbons, blown out of petroleum-cracking reactors in a continuous stream, are burned as they pass through a bed of the catalysts. Eighty percent of the heat is converted to steam; the remainder, sent through a gas turbine, is converted to electric power.

The new oxidation catalyst, basically of catalytic alumina and platinum alloy, was developed by Eugene J. Houdry, famed French-born dean of catalytic scientists and creator of the Houdry process of catalytic cracking of petroleum.

"While prospective savings in the refining industry are important, they are small compared to those expected to be realized throughout all of the coun-

NO GETTING AROUND IT!

De Laval Oil Purifiers Give Double Protection

There's no avoiding the fact that a turbine requires protection from *two* troublemakers—dirt and water. Any device that removes only the dirt does only half a job.

That is why De Laval Oil Purifiers are so much more effective for maintaining the purity of turbine oil than any other means available. They not only remove solid contaminants but also any moisture that may be present.

It is important to get such ***double protection,*** for oftentimes water, rather than dirt, is the real source of contamination. For example, condensate in oil leads directly to the formation of sludge, and, of course, if a water leak should ever develop, serious emulsification and real trouble might occur.

De Laval Oil Purifiers do not remove oil-soluble additives. The purifying action is entirely mechanical.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

for more dependable power production

Why you will continue to buy R-P&C iron valves...

• Because quality materials and high standards of workmanship insure long life and satisfactory performance.

R-P&C manufacturing controls from foundry to final test, together with the many years of accumulated experience of the workmen, are responsible for this high quality.

You get fine-grained, sound castings when you buy R-P&C Iron Body Valves. You get rod stock stems which have higher tensile strength. And you get the added strength of reinforcing tie ribs between bonnet and end flanges, plus ease of servicing because of separate yoke cap construction.

the Complete R-P&C line

BRONZE
IRON
CAST STEEL
FORGED STEEL
BAR STOCK

• All these features are yours, at no extra cost, when you buy R-P&C Iron Body Valves. See your local R-P&C distributor today or write us at Reading, Pa., for further information.

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

TRADE MARK

R-P&C valves

More POWER NEWS

Begins on page 148

try's industry," said Houdry, who is president of Oxy-Catalyst, Inc, a company he set up almost three years ago in Wayne, Pa., to manufacture the oxidizing catalyst.

Oxy-Catalyst, he revealed, is working with firms in 45 different industries on waste-conversion problems or pollution problems or both. They include chemicals, paint and varnish, food, asphalt, textiles and rubber.

The unit, measuring five and a half inches long, three and one-eighth inches high and three inches wide, is made up of two thick porcelain end plates and, between them, a porcelain spacer bar and 73 coated porcelain rods. Gases flow across the rods, each tear-drop in cross-section so as not to disturb the flow. The combustion occurs at the surface of the rods where they are coated with a .003 inch film of the catalytic agent—the catalytic alumina and platinum alloy.

Initial industrial success of the catalyst was in the metal-coating industry, at Enamel-strip Corp in Allentown, Pa. Installing the Houdry catalysts last spring, Enamel-strip cut its fuel bill 90 percent and solved a nasty air pollution problem at the same time. Instead of being vented into the atmosphere, noxious solvent fumes are converted into heat which is used to bake enamel on metals in a continuous operation.

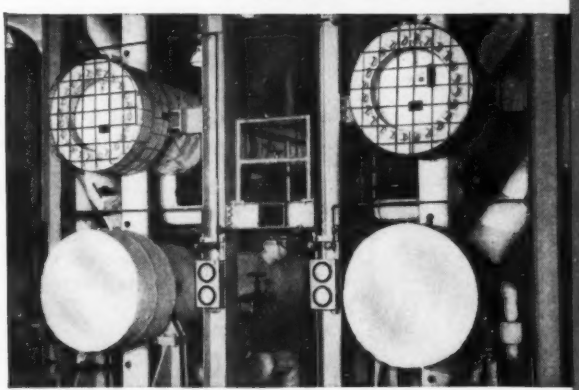
All indications point to a banner year in 1953 for the refrigeration and air conditioning industry according to information from the Refrigeration Equipment Manufacturers Association. John E. Dube, president of the Association, said, "We expect 1953 to be a good year for the refrigeration and air conditioning industry. Any reasonable decline of general business should be offset by the growth factor of our industry. This is particularly true with the advent of all-year-round air conditioning of homes." The year, 1952, has seen an average increase of approximately 30% in the business of manufacturers over 1951 and it is estimated that 1953 will increase another 30% over 1952.

London — (McGraw-Hill World News) — Boilers which will each burn seventeen hundred pounds of pulverized coal every minute are now being built for the British Electricity Authority's new power station at Castle Donnington, near Derby, England, the first British power station planned to have 100,000-kilowatt turbo-alternators, each driven by a single boiler. The units will each generate 830,000 pounds of steam an hour at a pressure of 1,600 pounds per square inch, and a steam temperature of over 1,000 F. It is expected that the first will start operating in 1955.

1 Evaporator Condensers
2 Closed Type Feedwater Heaters
3 Condensate Coolers
4 Jacket Water Coolers
5 Lubricating Oil Coolers
6 Evaporators
7 Oil Tank Suction Heaters
8 Fuel Oil Heaters
9 Blowdown Exchangers
10 Aircooled Heat Exchangers
11 Prefabricated Pipe
12 Propane Storage Tanks
13 Large Diameter Water Lines
14 Penstocks

check off your power plant needs

ALCO can meet them



For Example—Feedwater Heaters made by ALCO will meet your most exacting requirements because they have *all* these important features:

1. VIBRATIONLESS, TROUBLE-FREE OPERATION—support plates are of ¾ inch thickness or heavier, with tube holes drilled and reamed to a close fit and edges chamfered. Careful consideration is given to arrangement and spacing of tube supports to guard against vibration.

2. TUBE EROSION PREVENTED—alloy steel impingement baffles, one-quarter inch thick or heavier, are rigidly attached to the tube bundle support structure at points opposite the steam and drip connections to protect against tube erosion.

3. HEAT TRANSFER SURFACE EFFICIENTLY DESIGNED—tube bundles are designed to provide generous escape area and free-flowing distribution of the vapor throughout the shell space. Internal desuperheating and condensate subcooling furnished where required.

4. TIGHT JOINTS ASSURED—in all ALCO feedwater heaters, the tubes are roller-expanded into precision-drilled and reamed tube holes provided with parallel grooves. Full tongue and groove-gasketed joints are standard design.

5. CODES STRICTLY FOLLOWED—all ALCO feedwater heaters are designed and built to comply with the requirements of the ASME Code.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Dunkirk, N.Y.

***In step with tomorrow*—Alco Aircoolers, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

Mail the coupon for complete details about ALCO feedwater heaters and your other power plant equipment needs, or call your nearest ALCO Sales Engineer at Beaumont, Chicago, Dunkirk, Houston, Kansas City, Los Angeles, New York or Tulsa.

ALCO PRODUCTS DIVISION P
American Locomotive Company
Schenectady, New York

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CEMENT

- One coat insulates and finishes
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- Sets quickly . . . in two hours
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More POWER NEWS

Begins on page 148

Steam Specialty Mfr Handles Water Treatment

Strong, Carlisle and Hammond Co, Cleveland, Ohio, identified for over 50 years with steam traps, reducing valves and steam specialties, has announced its appointment as national distributor for the new Borgana boiler water treatment.

Several unusual claims are made for this product which is a liquid extracted by a complex process from red cedar wood. It was developed over the last ten years by the Chemical Div. of The Portland Shingle Co of Portland, Oregon, in cooperation with leading scientists.

Features claimed for the product are elimination of complicated boiler water tests, simplicity of use, "pre-proved" effectiveness, no danger from over-treating, reduction of corrosion and the elimination of scale in boilers, traps and valves. It is further said to be nonpoisonous so that the steam from treated boilers may be safely used in direct contact with food.

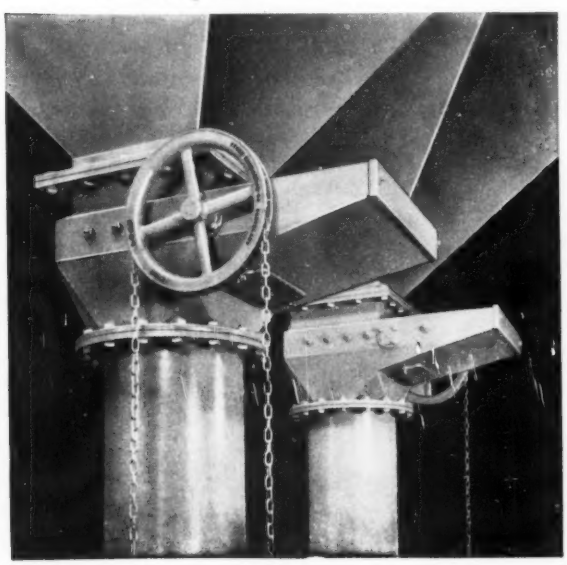
In addition to its use in boilers, Borgana also successfully treats cooling water in refrigeration and air conditioning systems, and other units where scale corrosion difficulties occur.

The gas turbine, one of the most versatile new sources of power for industry, is now being used successfully to pump natural gas through pipelines, according to an announcement by Paul Kayser, president of the El Paso Natural Gas Co. Kayser revealed that the first of twenty-eight 5000-horsepower General Electric gas turbines for the El Paso gas transmission system between West Texas and California has been placed in operation at Cornudas, Texas. When the remaining units are in operation within the next year, flow of gas through the lines will be increased about 300 million cubic feet per day.

London — (McGraw-Hill World News) — A new all-time record for new generating equipment was set up in the United Kingdom last year when additional output capacity of 1,539,000 kilowatts was brought into operation. The additional capacity was installed in 32 of British Electricity Authority's power stations. Seven of these are new stations. This compares with installation of new output capacity amounting to 1,113,000 kilowatts in 1951, the first year in which new generating plant exceeded 1-million kilowatts. The new capacity commissioned during the year brings the total of electricity output capacity to something over 15½-million kilowatts out of a total installed capacity of about 17,150,000 kw.

The Operator With a Sledge Hammer

S-E-Co. Coal Valves, available in sizes up to 42", are used in many central stations and large industrial plants.

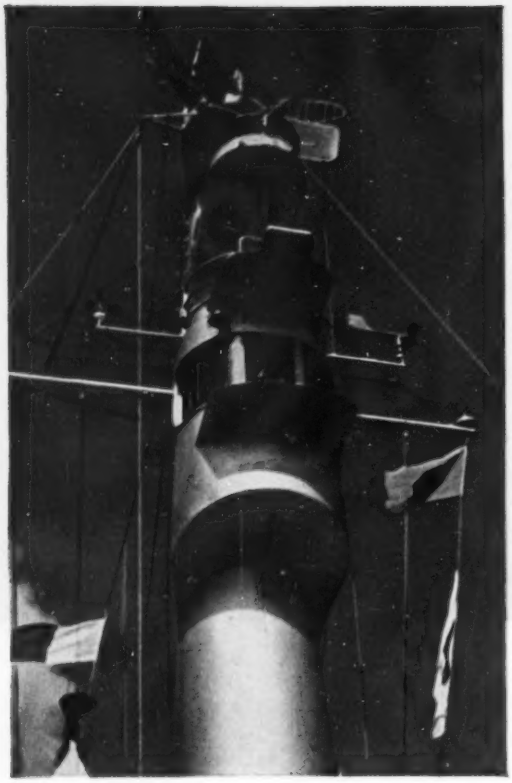


knows how to keep coal moving. But the anvil chorus he beats out on the bunker, valves and downspouts is far from pretty. It tells of damaged equipment — shoddy in appearance and short in life expectancy.

A sledge hammer does not belong in a modern boiler house. It is not a reliable means of overcoming coal stoppage, and when using it, the operator must neglect the economical operation of his boilers.

The best solution to the problem of coal stoppage is proper design of "Bunker to Pulverizer" or "Bunker to Stoker" equipment. As specialists in this field, Stock Equipment Company is in a position to assist plant designers with this problem on new plant design or renovation of existing facilities. Proper size of coal valve, proper slope to downspouts and proper shape of hoppers will do more to retire the sledge hammer from the boiler house than any other approach to the problem. Write for assistance with your particular coal flow problem.

STOCK EQUIPMENT COMPANY
745 P HANNA BUILDING
CLEVELAND 15, OHIO



Dramatic radar tower of the S. S. United States. The ship was designed by Gibbs & Cox, Inc., built by Newport News Shipbuilding and Drydock Co., and is operated by U. S. Lines, Inc.

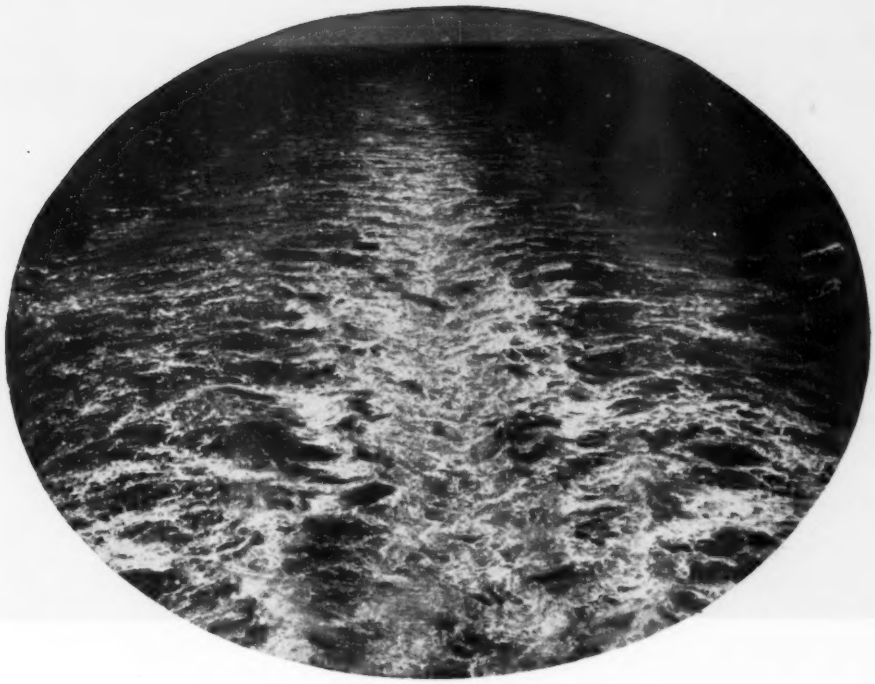
REFRACTORIES ARE SEA POWER!

The power of her mighty wake is a symbol of America's supremacy of the seas! But the S. S. United States would not be churning through the water with such ease, but for the *power* of industry that made her possible. Power—which in itself was made possible because of *brick*.

Refractory brick . . . in the boilers that generated the electrical power to roll her steel and aluminum, draw the copper wire for her miles of electrical connections. Power that moved the giant lathes which turned her shafting and screws to such a fine tolerance that you can hardly see them move.

General Refractories Company has long been a major supplier of quality refractories to all who require steam boilers or furnaces in their operations. From 66 mines and manufacturing plants, here and overseas, GREFCO products are available in quick and dependable supply.

In applications where a complete or partial monolithic enclosure is desired, power engineers know that there is noth-



ing finer in the market than GREFCO plastics—BRIKRAM and SUPER BRIKRAM—and hydraulic setting castables—BRIK-CAST, SUPER BRIK-CAST, BRIK-CAST 3000, LITECAST, LITECAST 50, BASICRETE and BASICRETE 3100.

Where brick is the preference, proven and dependable brands of high duty fireclay brick such as WYNN, ACME, OLIVE HILL, BEECH CREEK, SALINA and RANGER are available in standard or special sizes. If the service indicates super duty fireclay, the quality brands of HIAC or SUPERAC are available. For the really tough service there are the several brands of high alumina brick, GREFCO SILLIMANITE and CARBEX silicon carbide.

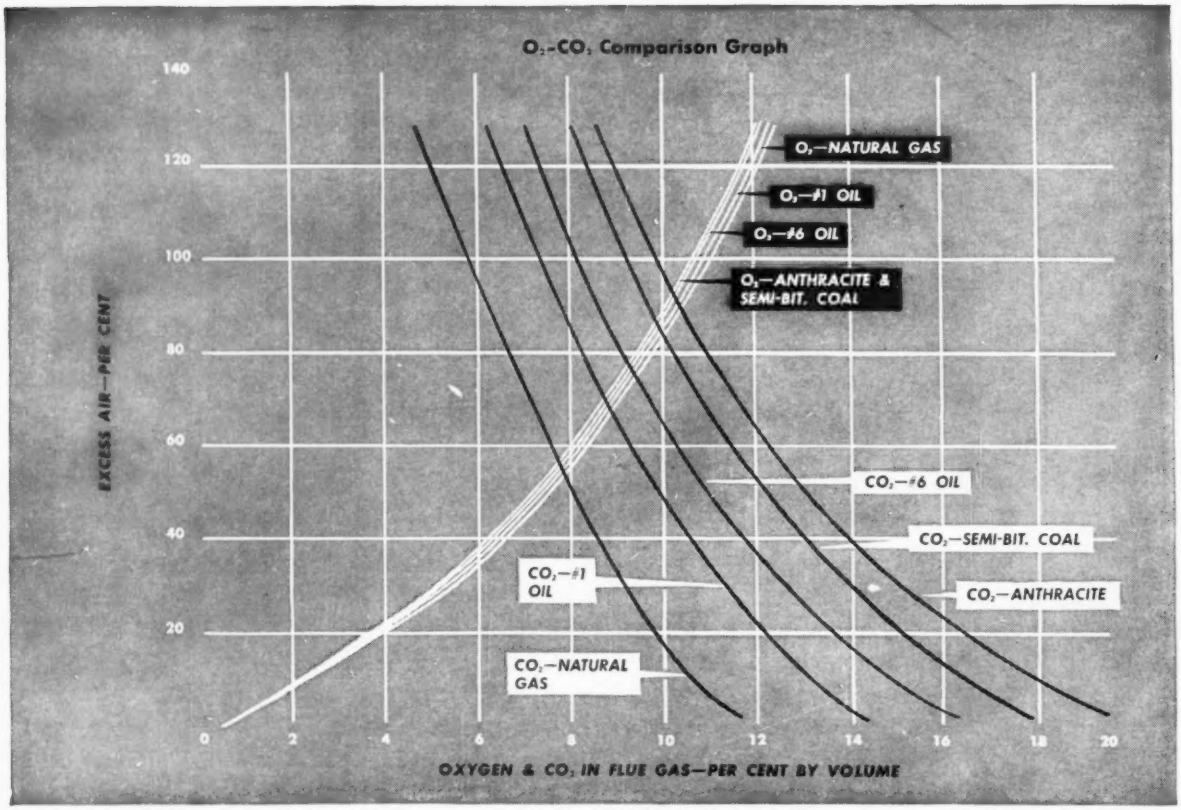
Mortars, too—just the correct type for each service condition. BRIKLOK A or BRIKLOK B, KROMEBOND, SILLIMANITE, C-32, EVERHARD—proven and high quality brands of air-setting and heat-setting mortars are designed for excellent workability and maximum service.

So whether your refractories problem has to do with stationary power, conquering the high seas, or driving a locomotive down twin ribbons of steel—call on GREFCO. You can be sure of the best—when and where you want it. And you can rely on GREFCO technicians for advice and counsel. Truly, GREFCO offers a *complete refractories service.*

GENERAL REFRACTORIES COMPANY
PHILADELPHIA

GENERAL REFRACTORIES

How to burn Multiple Fuels efficiently



Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 30% excess air range) the CO_2 curves diverge widely.

Large Savings Possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

They purchased a Hays Magno-Therm Oxygen Recorder, and immediately found that their boiler operation was so inefficient that the pen would not stay on the 0-10% chart. However, by operating with reference to the O_2 recorder they were able to reduce fuel costs enough *to pay for the instrument in 40 days.*

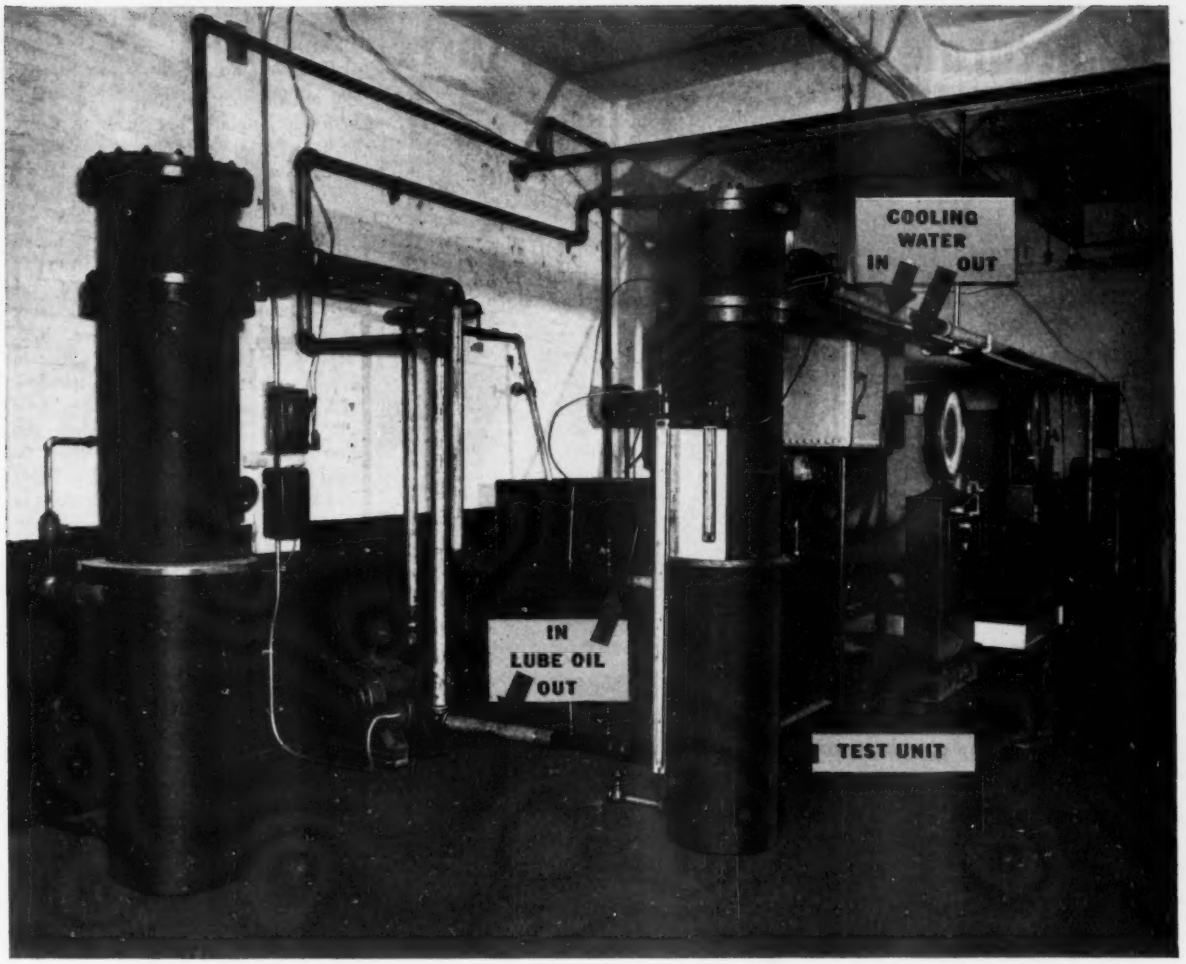
With the Hays Magno-Therm Oxygen Recorder you get:

Continuous, highly accurate indication and recording.
Complete compensation for temperature and pressure effects.
Freedom from chemicals or hazardous fuel burning in the analyzing process.
Swift, sure electronic operation.

If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this O_2-CO_2 Comparison Graph as well as Hays Bulletin 50-829—describing the Magno-Therm Oxygen Recorder. Write for this free information.

THE **HAYS** CORPORATION
MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders



PERFORMANCE-TESTING ADSCO LUBE OIL COOLERS

Here's a picture with a big story! It shows performance tests being run on one of a large group of ADSCO Lube Oil Coolers.

These tests prove conclusively that everything claimed for these coolers will be performed by them when installed... because the tests are conducted under actual operating conditions in ADSCO's testing laboratories. And here's how the tests are run: Before the lube oil enters cooler at 130 g.p.m., it is brought up to specified temperature of 150F. by unit at left and then cooled to 130F by 250 g.p.m. of water entering cooler at 115F and leaving at 119F. Inlet and outlet temperatures are checked by thermometers. Pressure drops for both shell side and tube side are determined by manometers. Oil and water are collected in reservoirs and weighed in tanks on scales to determine capacities.

This testing service puts a pedigree on ADSCO Heat Exchangers. These units, engineered and tailor-made to requirements, come to you exactly rated when tested by ADSCO. The exchanger can be put in the line with complete assurance it will do the job.

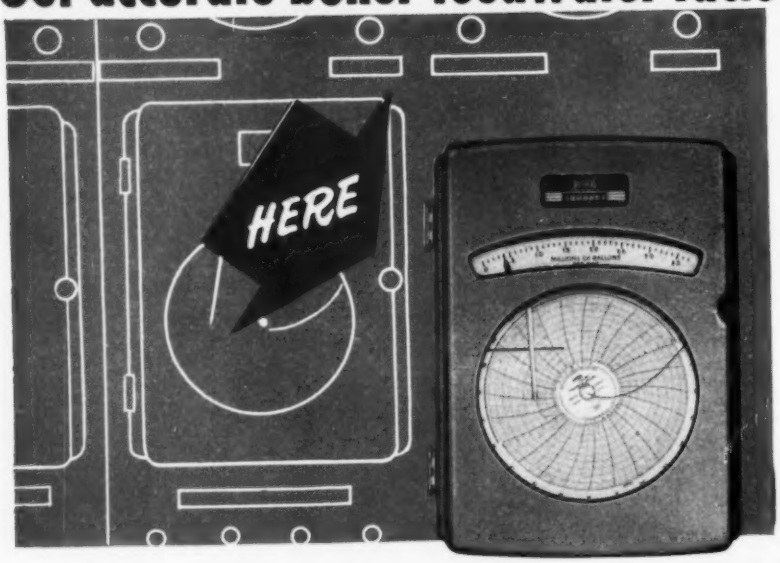
Expansion Joints • Separators • Meters • Steam Traps • Heat Exchangers • Strainers

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

Get accurate boiler feedwater facts



Now you can keep track of boiler feedwater consumption with this Totalizer-Indicator-Recorder right at your central control panel. Builders Propeloflo Meter totalizes the flow on its direct reading register on the meter body — and can also transmit the accurate flow story over a simple two-wire circuit. The Propeloflo Meter is completely self-contained and self-operated, and requires no external power source. Standard designs are available for temperatures up to 275°F. and for 150# and 250# operating pressures. Power for the complete transmitting and receiving system (110 volt, 60 cycle A.C.) is supplied from the receiver end of the circuit. The receiving instrument may be panel, wall, or panel-stand mounted.

HERE GET THE FACTS— SEND COUPON TODAY!

B-I-F INDUSTRIES **BUILDERS - PROVIDENCE, INC.** BUILDERS
(DIVISION OF B-I-F INDUSTRIES)
354 Harris Avenue, Providence 1, Rhode Island

Please send Bulletin 380-J17 describing Builders Propeloflo Meter.

Name.....
Company.....
Street.....
City..... State.....

MARMADUKE

Continued from page 142

ping out the next winter.

"When I finally got back to camp the next Sunday morning, there was a lot of excitement. One of the bright young firemen, by the name of Harry Nixon, told me it was hard to keep up steam because the clapper chain had broken near the top of the stack the day I left. Sure enough, the screen was badly plugged. Flames and smoke shot out when I opened a furnace door. There was just about enough steam to keep the cage running at half speed.

"A crowd gathered around me in no time to see what I'd do. Then the super came on the double when he heard I was back. He waved a letter from the home office that had come in on my plane. It was from the engineering department.

" 'We can't shut down or we'll fall way behind schedule,' wailed the super, who was a crackerjack mining engineer but was a little short on imagination. 'I just got these suggestions from the home office. See what you can do about carrying them out.'

"I took a look at his letter. The brain trust in the home office had four brilliant suggestions. One was to screw 60 feet of pipe together to reach that screen and hook the piping to our compressed-air supply. The second was to build a ladder to reach the stack's top so we could knock that soot free. The third idea was to beat the stack above the roof with long poles. Brain storm in back of this last suggestion was that the stack might vibrate enough to loosen the soot. A fourth was to squirt water up there and wash the soot back down inside the stack.

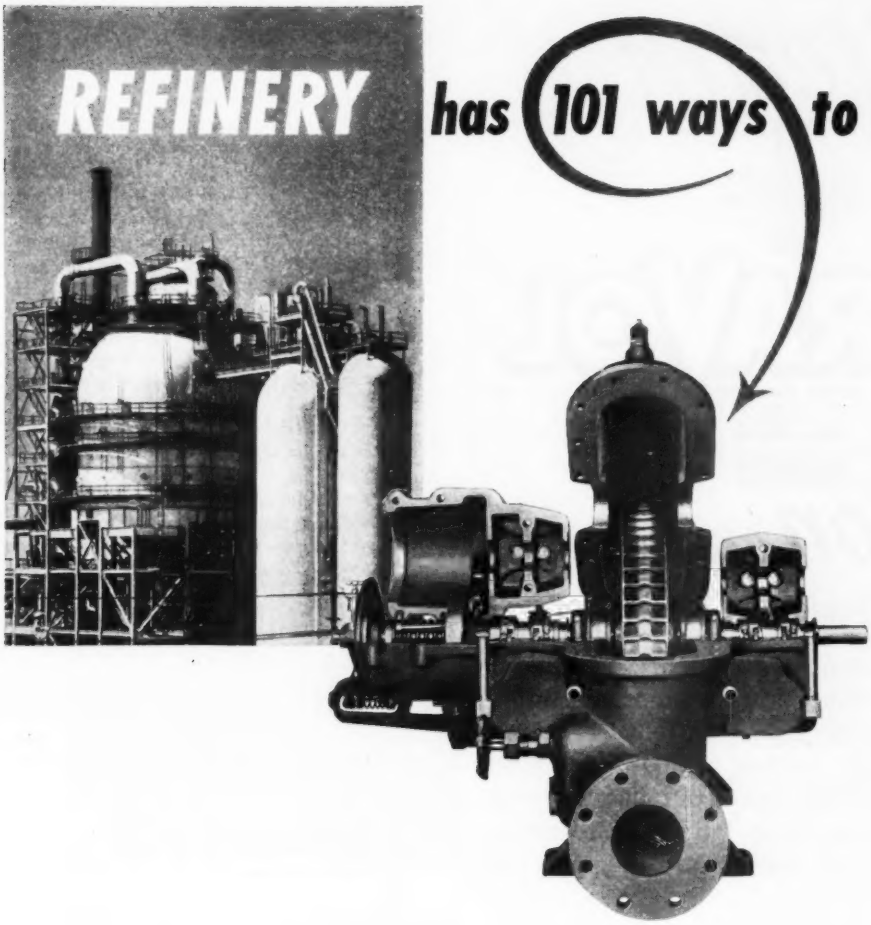
" 'Wadya think, Chief?' said the super hopefully, 'think you can get any of these ideas to work? Because if you can't,' he added quickly, 'we'll just have to shut down after all.'

"The boys crowding around began arguing about those suggestions while the super was talking with me. One character claimed the ideas were screwy, while another believed the air-line idea might work. In almost no time a red-hot argument was going on, with everyone choosing sides. I guess the boys had been drinking a little because it began to look like a young riot.

"Then I noticed Indian Moose standing near the crowd, taking it all in calmly. Moose lived down the river and usually earned a bottle of firewater by hiring himself out as a guide when the boys explored the surrounding mountains. Moose was leaning on his shotgun, minding his own business.

" 'I'll stop this argument before someone gets hurt,' I yelled at the super. With that, I ran toward Moose and

REFINERY has 101 ways to save money



When the yearly cost of replacement parts for 101 steam turbines averages *only 1.6% of the initial investment*, you are saving money . . . and plenty of it.

This amazing record was established by Terry turbines at a large refinery on the Atlantic coast. The percentage figure was determined by means of an accurate tabulation of the cost of replacement parts required over a two-year period.

These 101 Terry machines provide a good cross section of the various types of small and medium-size turbines made by the company. Ranging in size from 10 to 1200 horsepower, they include single and multistage axial flow designs as well as the famous Terry solid-wheel turbine.

Such outstanding performance records are not at all unusual for Terry turbines. The thousands and thousands of these machines installed in refineries throughout the world provide an accurate yardstick for measuring turbine reliability.

Send for illustrated bulletins. No. S-116 describes the many advantages of the Terry solid-wheel turbine. For multi-stage turbines, ask for a copy of Bulletin S-146.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1194

Steam plus CORAVOL (The Original* AMINE PROCESS) ® = Protection (FROM CORROSION)

Because CORAVOL Circulates to Control Corrosion

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** *you* will use is formulated to do the best protective job under your own plant conditions.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special chemical formulas for: boiler feed water . . . foam prevention . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

Chemical Water Treatment

WESTERN CHEMICAL COMPANY

713 Washington Street
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MAIL COUPON TODAY for
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713 Washington Street,
Kansas City 6, Missouri
Send me full information about CORAVOL.

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CITY _____ ZONE _____

STATE _____

MARMADUKE

Continued from page 204

started grabbing the gun out of his hands. He probably thought I was going to shoot someone because he got a strangle hold on his gun with both hands. But I yanked it away and aimed at the screen on that stack. When I pulled the trigger, the loud blast stopped the arguing. It also sent soot flying in all directions as the shot peppered the screen. A lot of shot evidently went right on through, leaving a wake of soot behind, like the tail of a comet. Then I blasted away again from the stack's other side.

"Harry Nixon ran back inside the fire room to check his boilers. We all piled in after him. The fires were really starting to roar.

"Plugging a plugged screen with a shotgun to unplug it is not according to the books," roared Marmaduke, "but it saved the day. And we used that gun plenty before we could shut down months later to fix that chain so it stayed fixed.

"As we say at sea," wound up Marmaduke, ballasting his double bottoms with a cargo of Sandpaper Gin, "any old port in a storm—so long as you save the ship."

FIGHT POWER COSTS

Continued from page 102

studies we often have to dispose of waste gases from process areas in the power boilers. They can represent combustion and control problems. Power-plant stacks, likewise, can be expensive items since they should be of a height that eliminates atmospheric nuisance headaches.

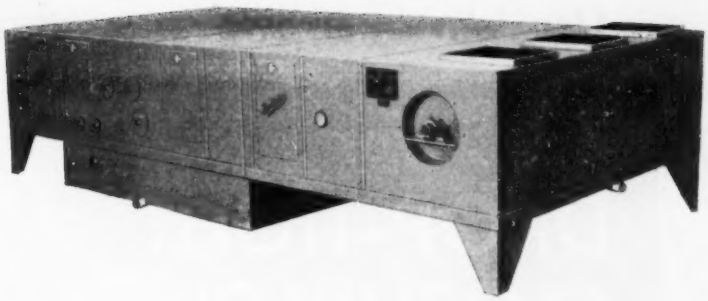
"Fuel handling is mostly of the conventional type, but we try to integrate with fuels used in other parts of the plant. We're always on the lookout for a low-cost way of getting coal from car or barge to stoker or pulverizer.

"Dust and ash handling covers all equipment to remove, convey and store ash and flue dust from boiler outlet, stoker, flue, dust collector or chimney hopper to point of final disposal. Older, existing plants are the ones that suffer most in investment costs in this phase. We have to rework and use all present facilities as far as possible. Usually, though, we wind up cutting holes in the roof, relocating fans and drives, adding structural steel for supports. Then we have to rework the fan casing, perhaps buy a new wheel, rewind the driving motor to meet the increased draft loss through the dust collector. Flyash disposal poses a major problem. When engineers can figure out a way to make this item fit for industrial service, they'll

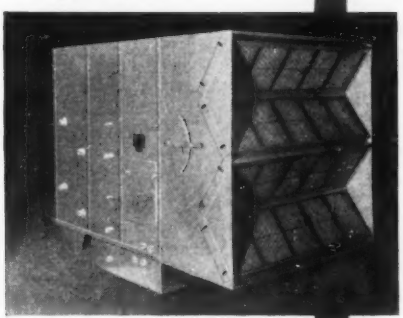
easy to install

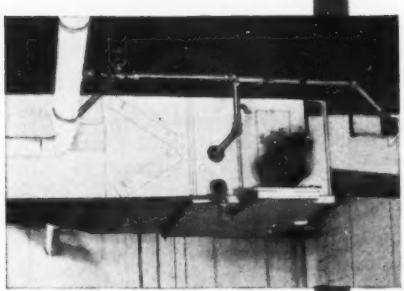
easy to live with

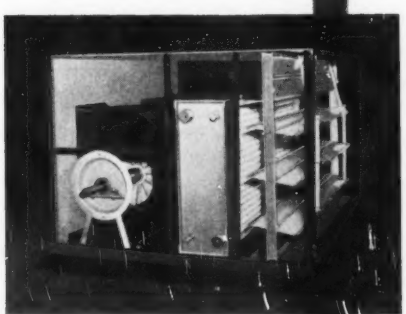
"Buffalo"



"PC" CONDITIONING CABINETS







When you air condition, you want three things—as inexpensive a job as will do, equipment that installs economically—and most important—equipment that gives satisfaction over a long period.

Cost-wise, the central cabinet is the least expensive part of your system; considering compresser, ductwork and building modifications.

Satisfaction-wise, it's the most important!

If the fans are over rated, or inefficient, you'll suffer. If the coils are inefficient or untrustworthy, you'll have poor air conditioning.

Why not be sure that on this lowest-cost part of your system, you get the best?

"Buffalo" "PC" Air Conditioning Cabinets, to heat, cool, humidify or dehumidify, or any combination of these functions, have been in use for more than twenty years. They are sectionalized, to pass thru standard building openings, and assemble easily on location. They have husky, quiet, mixed flow fans mounted on large, vibrationless hollow shafts. They have Aerofin coils, by far the best obtainable. They have sturdy, outside-the-housing bearings, for convenient lubrication even after cabinet insulation. In short, they are built according to the "Q" Factor* which makes them your best buy!

"Buffalo" Engineering Sales Representatives in principal cities are anxious to serve you. Let them give you full details—no obligation.

★ *The "Q" Factor—The built-in Quality which provides trouble-free satisfaction and long life.*

DIAMOND JUBILEE 75TH ANNIVERSARY

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

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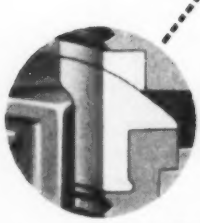
VENTILATING | PRESSURE BLOWING | AIR CLEANING | COOLING | AIR TEMPERING | HEATING | INDUCED DRAFT | FORCED DRAFT | EXHAUSTING

Use 'em over and over again

for DROP-TIGHT CLOSURES!



Dart's True Ball Joint Makes the Difference

Dart Unions are leakproof on the pipeline and on the pocketbook. They're spherically ground to a true ball joint with wide, true-bearing surfaces. Because seats *stay* unscarred and true, these unions won't leak—and you can use them on job after job.

QUICK FACTS

- SEATS of special alloy bronze provide high resistance to pitting and corrosion
- BODIES AND NUTS are practically indestructible. They're air-refined, high test iron
- SHOULDERS are tough and heavy — made to take the most violent wrenching

Ask your supplier for Darts. You'll save money and leaks. And, if you do the installing job yourself, you'll save muscle and sweat also!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston·New York·Pittsburgh·Rome, Ga.

DART
UNIONS

FIGHT POWER COSTS

Continued from page 206

have taken a long step forward in reducing investment costs.

"Feedwater treatment costs differ greatly plant to plant, and the reasons are obvious. If you can tie process and powerhouse needs into one large treatment system, you reduce unit investment costs. But it's a highly individual job.

"Piping, which embraces pipe, hangers, anchors, expansion joints, drips, drains, traps, vents and insulation, always impresses me. It runs from 7 to about 24% of the total powerhouse investment. We constantly aim at establishing standards that give us the cheapest piping construction consistent with codes and satisfactory service life.

"Our figures, Table III, do not include any facilities for electric generation. Here we cover necessary electrical distribution elements, instruments and controls. We make every effort to hold individual devices to the same types used elsewhere in the plant. It saves maintenance men from having to learn a number of different designs serving the same function. What's more, it reduces required storeroom stocks.

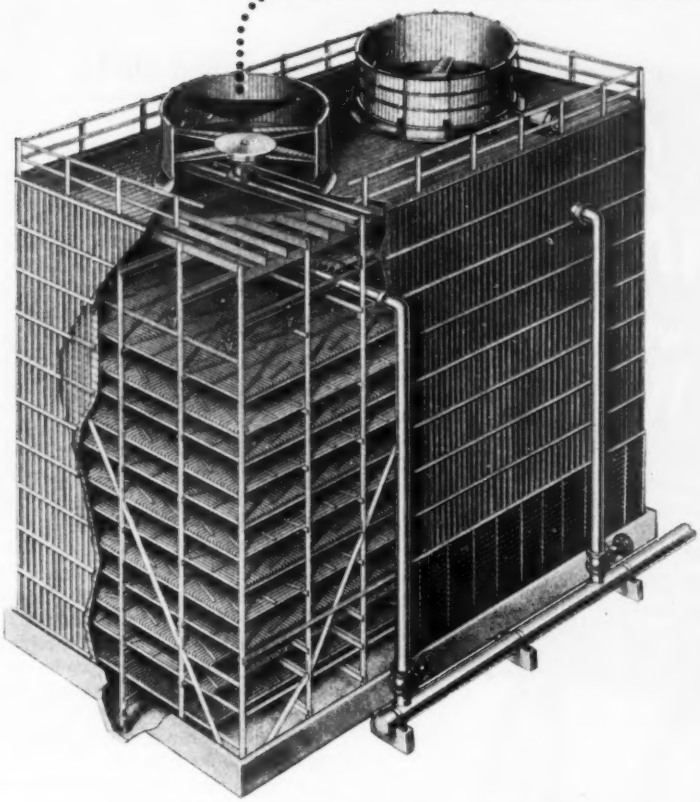
"Building-construction costs have been the greatest area for savings in recent years. The reason, of course, is the trend towards outdoor construction everywhere. This idea has been carried to the point where one of our newest plants has got away with a building investment only slightly over 10%."

CONSTRUCTION COSTS

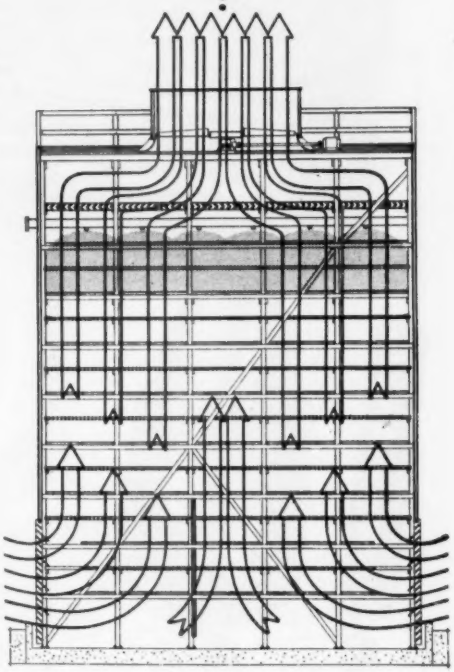
Fearnside and Cheney: "We find engineers frequently called upon to give 'off the cuff' estimates of total costs of a proposed power plant. For the industrial you can't tie it to boiler capacity because it has no relationship to kw output, nor for that matter does turbine size check with condensers. So we have tried to establish three simple factors—one each for boiler plant, turbine equipment and condenser installation. Switchgear capacity has a definite relationship with turbine size so we consider it a part of the turbine plant.

"Better-known manufacturers can give you on fairly short notice accurate estimates of current purchase costs for boilers, turbines, switchgear and condensers. Total costs of construction including field labor bear a more or less constant relationship to market prices of these major equipment pieces. With this background and a list of known costs of completed projects, covering all types and sizes of jobs from 1946 to 1952, a series of factors can be worked up. And this is what we did.

"The factors are simply multipliers which you apply to a single manufac-



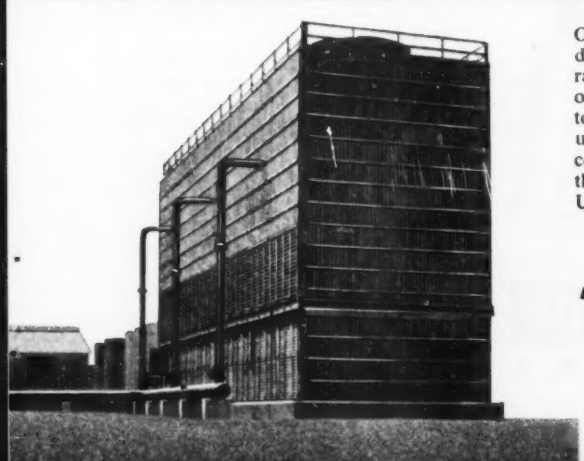
Efficiency of FLUOR COUNTERFLO Cooling Towers begins at the top



Heavy stainless steel fan blades are finely balanced, resist corrosion and are mounted on shafts whose exceptionally high fatigue strength has been substantiated by strain gauge tests and actual use. Pitch is adjustable to efficiently handle required air volumes at minimum tip speeds and horsepower requirements – more air per kilowatt. Speed reducers incorporating spiral bevel gears feature oil-bath lubrication and dry-air breather. The low-speed fan shaft is mounted on special steep angle thrust with radial bearings to take the combined gear thrust, fan thrust and weight of fan assembly. Driving mechanisms are built for hard-wearing, maintenance-free performance and for smooth, quiet operation.

Vibration Cut-out switches, exclusive with Fluor Cooling Towers, are an emergency safety device that stops the motor should excessive vibration accidentally occur, preventing possible damage to the tower or mechanical equipment. Design employing internal gusset plates duplicates that used in wooden bridge construction. These connectors add greater tensile and compressive strength to structural members, lower the total weight of towers, require less erection time and materially increase tower life. Sloping grid decks of rough-finished redwood with minimum one-inch dimension are used as scaffolding during erection and provide maximum deck surface with negligible air pressure drop through the tower.

Air distribution is controlled at every stage of its travel through the tower. Louver height is designed to obtain the desired intake velocity and wind-deflectors inside the tower uniformly direct air currents to all areas. Approach to the desired wet-bulb temperature is easily accomplished and performance to customer's specifications is guaranteed in every case.



Only Fluor Counterflo Cooling Towers are completely prefabricated. All cutting, drilling, and nailing is performed at the factory and tower parts are "packaged" for rapid delivery, marked for orderly assembly. More efficient control of the quality of straight-grained heart of California redwood and excellent workmanship in Fluor towers are maintained through prefabrication. Inexperienced craftsmen and laborers under Fluor's supervision can erect a Fluor tower in a minimum of time and at considerable savings in erection costs. Prefabrication means standardization; parts that may become worn or damaged over the years may be replaced economically. Uniformity of appearance as well as performance is assured.

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Rotojet Junior Tube Cleaners are powerful, yet light in weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Simple design and precision construction assure long service, efficient use of power, and freedom from trouble. Clean tubes from .495" to 2.062" I.D.

Bulletin J-410 shows Rotojet Junior motors and accessories to help you do a faster, more thorough tube cleaning job. Send for your copy.

S32 ROTOJET Junior Air-driven Motor, cone cutter, universal joint.

C439 ROTOJET Junior Air-driven Motor, universal joint, drill head

C324 ROTOJET Junior Water-driven Motor, univ. joint, pivot head.

C434 ROTOJET Junior Air-driven Motor, flexible coupling, expanding brush.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue Newark 1, N. J.

FIGHT POWER COSTS

Continued from page 208

turer's estimate to get an approximate erected cost of that portion of a power-plant job.

"The Boiler Factor, arrived at by dividing erected cost including indirect mechanical and electrical items of the 'boiler plant' by total purchase price of the boiler components proper, turned out to be 3.61 for seven widely varying jobs (Described in full in the author's paper. See 'The Experts,' p 100.)

"These erected-cost items include complete boiler unit including economizers, burners, air heaters and boiler-supporting steel; draft fans, duct work and stacks; pulverizers, coal scales, chutes and within-building conveyors, but not including bunkers, considered a part of the building; heat exchangers and pumps with drivers; tanks installed within the building or on the roof; all station auxiliary electrical equipment pertaining to boilers and boiler auxiliaries including motors, station service switchgear and transformers, cable, conduit; valves and piping associated with the boiler; instruments, controls and gage boards; insulation, equipment painting, preliminary operation costs.

"The purchased price referred to involves only boilers, including water-cooled furnaces, superheaters, economizers where used, air heaters where used, burners, interconnecting ductwork, stokers and overfire systems where used, pulverizers without chutes or coal air piping, main supporting structure normally supplied, casings and buckstays, refractory and insulation materials at erected cost since this is the usual way this is supplied.

"The Turbine Factor developed in a similar fashion, came out 1.69. It was reached by dividing erected cost—including indirect charges, of all mechanical and electrical items held to be a part of the turbine-generator and main power switchgear installation—by the total purchase price of the turbine-generator and the main power switchgear for seven different jobs. More fully described in the authors' paper. See 'The Experts,' p 100.)

"Erected turbine and switchgear cost items include complete turbine-generator unit with oil coolers, air or hydrogen coolers, ductwork and oil-filtering system; station crane; turbine support exclusive of excavation and piling; gland sealing-water tank; valves and piping associated with the turbine; associated instruments and controls; all station auxiliary electrical equipment associated with the turbine-generator including station service gear, transformers with conduit, cable and accessories; insulation, painting and preliminary

HOW Carey HELPS THIS

power plant in the sky

KEEP OPERATING COSTS down to earth

Arapahoe Station, Public Service Company of Colorado

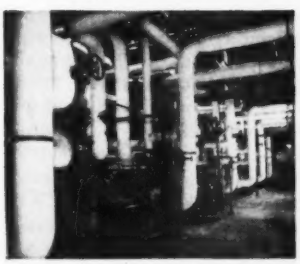
B & B Engineering and Supply Co. Inc., Houston, Texas—Insulation Contractor ● Ebasco Services, Inc., New York City, Design Engineer and General Contractor

At this new 132,000 kw, steam electric generating plant – built at an elevation of over 5200 feet – Carey insulation products conserve heat, save fuel, help satisfy the West's growing appetite for low cost power.

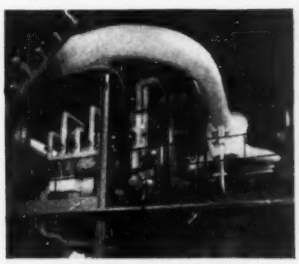
Carey insulation products were chosen for Arapahoe on the strength of their proven ability to meet, economically, all requirements for strength, lightweight, dimensional stability and performance on a wide range of equipment, operating at temperatures to 900° F.

Development and manufacture of products for heat conservation has been an important Carey service to industry since 1873. That's why we believe we can solve *your* heat conservation problem, no matter how unusual it may be. The Carey line includes new, monolithic Super-Light 85% magnesia in molded pipe coverings, blocks and cements – now being manufactured in our new multi-million dollar plant. This material is light-weight, strong, easy to handle, easy to apply. It will not disintegrate or crack under normal service conditions and can be removed and reapplied, when necessary.

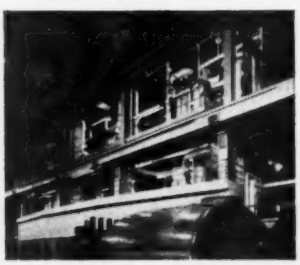
Call on Carey for the solution to your heat conservation problems. Use the coupon to request the latest bulletins describing uses for Carey insulation products. If you wish, the coupon will also enlist for you the services of a qualified Carey Industrial Sales Engineer. No obligation.



● In the boiler feed pump room, feed water discharge lines and recirculating lines are insulated with 2" thick Carey 85% magnesia insulation. Finish is 8 oz. canvas on rosin sized paper. Boiler feed water suction lines insulated with Carey standard thickness 85% magnesia, finished with 8 oz. canvas over rosin sized paper.



● The main steam lines and stop valve to turbine, where operating temperatures reach a maximum of 905° F. 8" and 12" pipe, insulated with 2" thick Carey Hi-Temp and 2" thick Carey 85% magnesia, finished with ½" Carey asbestos cement, layer of asbestos paper, layer of asbestos cloth, sewn on with copper wire.



● View of Arapahoe Station from turbine floor. Elevation 5287'. Workmen are applying 8 oz. canvas to lines.

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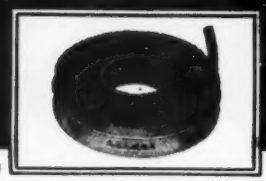

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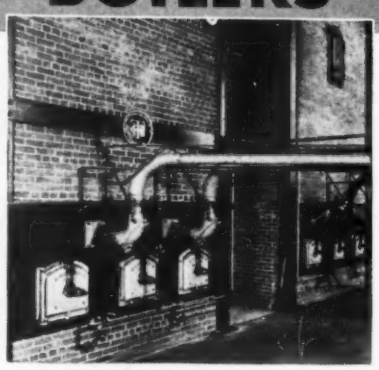

State Teachers College, Edinboro, Pa.

Two Titusville TDs Boilers, 160 lb., pneumatic spreader stokers. Contractor: Dravo Corporation, Pittsburgh, Pa.

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FIGHT POWER COSTS

Continued from page 210

operation costs chargeable to turbine-generators.

"Purchase price covered only turbine-generator with exciters, oil coolers, air and hydrogen coolers, main power switchgear but no station service gear or transformers.

"Condenser Factor was arrived at through much the same approach, and for four jobs had a weighted average of 1.86. The erected cost, including indirect charges, took in the condenser system with tubes, circulating water and condensate pumps, air jets, circulating-water piping to station wall, screens and the portion of auxiliary electrical work chargeable to condenser auxiliaries. The purchase price was made up of condenser, tubes, air jets and pumps with drives.

"By applying these factors to the purchase costs of the major elements we get an estimated figure that represents about 75% of the total. The missing 25% is chargeable to building (roughly $0.65 to $1.20 per cu ft; depending on type) foundations, special applications."

SUPERHEATER SLAG

Continued from page 88

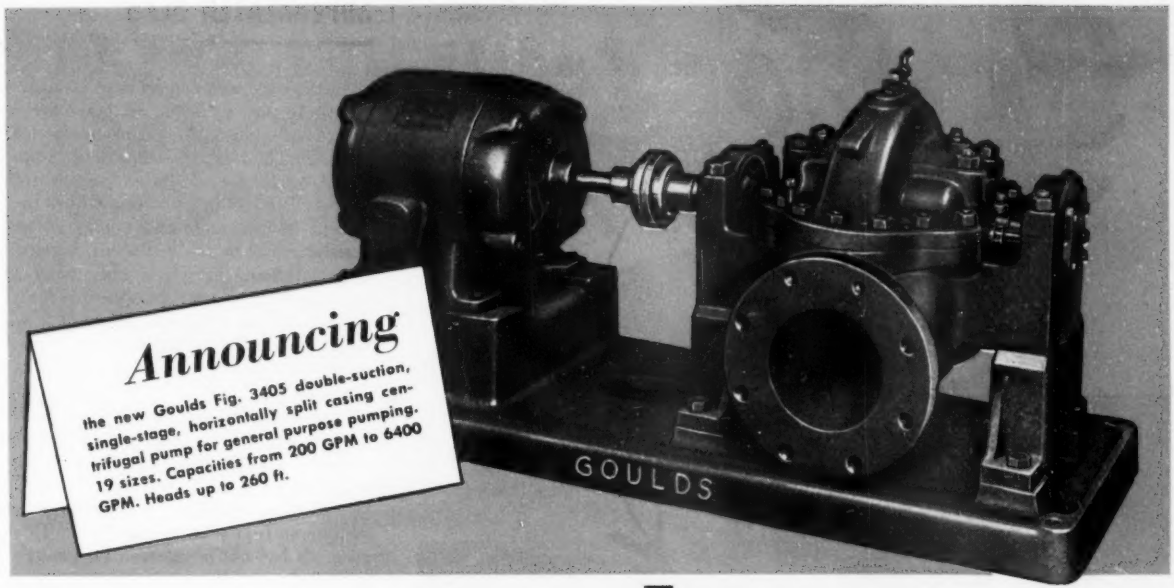
oil, dew-point temperatures from 250 to 275 F were recorded. This indicates a possibility that air-heater metal temperatures above 150 F would be sufficient to prevent corrosion with dolomite additive, whereas, metal temperatures above 275 F would be required without additive.

Analyses of superheater deposits before and after using additives are indicated in the bar chart on p 87. Without additives the deposits were a semi-fused, rocklike substance. With additives the deposits are granular, softer, more powdery.

Analysis of the deposit formed when alumina is the additive shows an Al_2O_3 composition of 53.7%, which indicates that the alumina is depositing with the ash in the same proportion in which it is added to the oil. Fusing temperatures are all above 2900 F.

In analysis of the deposit with dolomite, total sulfur as SO_3 is 44.8%, indicating that the ash with dolomite is more reactive to sulfur compounds than that with alumina. The V_2O_5 with dolomite is 4.9%, which may be attributable to either change in the oil-ash analysis or dilution. Fusing temperatures with dolomite are lower than with alumina, but still considerably higher than before using additives.

Dolomite has been the additive at Inglis for about one year. There is every


Announcing
the new Goulds Fig. 3405 double-suction, single-stage, horizontally split casing centrifugal pump for general purpose pumping. 19 sizes. Capacities from 200 GPM to 6400 GPM. Heads up to 260 ft.
GOULDS

This new pump gives you 5 big cost advantages

The price you pay is only one element of the cost of a pump installation.

Good engineering practice also figures in the cost of pump breakdowns, low operating efficiency, changeovers to meet new conditions, replacement parts inventories, even the floor space the installation takes up.

Here's why the new Goulds centrifugal pump is designed to improve your cost experience in every one of those elements.

1. *It combines seven design features that mean maximum operating efficiency and minimum maintenance.*

Every one of these construction features is standard with this new design. Together they offer you, without extra cost, a quality of service that's unique in its approach to general liquid handling.

a. Renewable stuffing box bushings.
b. Bearing housings sealed against moisture and dirt.
c. Cowl-type glands suitable for use with quenching liquids.
d. Stainless steel impeller keys.
e. Teflon water seal rings.
f. Die-formed stuffing box packing.
g. Corrosion resistant gland bolts.

2. *Interchangeability of parts.*

With only three shaft and rotating parts assemblies to provide for 19 pump sizes and 38 pump combinations, this new design offers you a remarkable range of interchangeable parts. A glance at the interchangeability chart on page 7 of the descriptive bulletin will show you:

a. how this design gives you great flexibility in making field changes should your pumping requirements change;
b. why the first cost of this unit is so low due to standardization in manufacture; and
c. how this interchangeability helps to reduce spare parts inventories.

3. *Compact construction.*

You will be particularly pleased with the short over-all length of this new design. Short bearing spans cut lengths as much as 50%. This means a real saving in floor space.

4. *Flexibility of stuffing box.*

You can use either conventional stuffing boxes or mechanical seals depending on requirements. And you can change from one to the other in the field if need be.

5. *Easy rotation change.*

A unique device, locking shaft seals, permits you to change from right-hand rotation to left-hand rotation or vice versa in the field without construction changes.

More than 50 years of experience in meeting industry's needs for general purpose centrifugal pumps come to a climax in this design.

GET FULL DETAILS **This 12-page illustrated bulletin, No. 721.6, covers the complete details of the new Goulds Fig. 3405, including specifications, interchangeability tables and performance curves. Be sure you have the whole cost-advantage story before you select another general purpose pump. Contact your nearest Goulds representative or mail the coupon below today.**

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Please send me Bulletin No. 721.6 describing the new Fig. 3405 centrifugal pump.

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Design capacity 256,500 cfm @ 383°F. 28.65" Bar; 10.16" SP; 705 RPM 595 HP. Special control type louvre inlet dampers; outlet dampers; inlet boxes; air-cooled bearings and sun shields.

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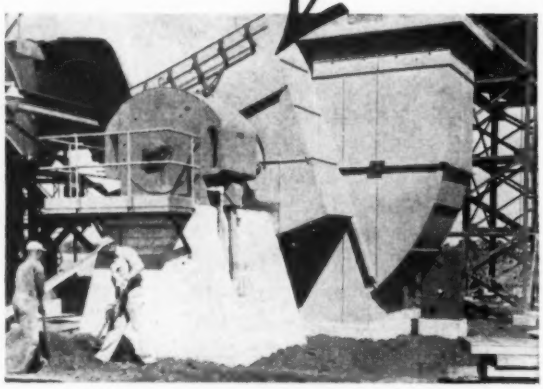

*Designed by Ebasco Services Incorporated

Two exacting buyers were involved in this installation: the owners and the consulting-design engineers. That they have entrusted to Green Fans the important work of supplying combustion air is in itself a stamp of approval. Their decision might be helpful to you in selecting fans for your power plant project.

We have been designing and making draft fans for 48 years. This is indicative of our experience. We have supplied fans for many of the leading utility and industrial power plants now under construction or recently completed. This is indicative of our modern designs and fabricating methods.

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THE GREEN Fuel Economizer COMPANY INC.

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BEACON 3, NEW YORK

SUPERHEATER SLAG

Continued from page 212

indication the unit can be kept clean indefinitely with a 200-psi air lance every five to seven days. To permit access for adequate lancing, we installed additional lance doors. Based on results, Florida Power Corp has taken over the system and is adding dolomite in an amount equal to ash in the oil as regular operation. They are also using a similar dolomite additive system at their Turner Station where there is a B & W Type FH boiler like the one at Inglis. Source of oil burned at both plants is the same.

High-Temperature Corrosion. Possibilities of additives to prevent high-temperature oil-slag corrosion is being investigated at the research center and in the field. Additive systems similar to that at Inglis are being used. This program has not progressed far enough to evaluate results.

In considering additives to alleviate slagging on other jobs, remember this method is relatively new and will undoubtedly involve additional problems. As an example, on jobs fired with return-flow burners it will be necessary to recirculate the additive-treated oil back to the high-pressure pump suction and in some cases back to the storage tank. This will raise some problems in connection with wear of pumps and regulating valves and the possibility of additive settling in the storage tank. A method of controlling the rate of additive feed will have to be worked out to suit the oil-flow system at a particular job.

Additives have not yet been tried with a wide variety of oils so there is no definite assurance that a certain additive will always be equally effective.

RADIOACTIVE GEARS

Continued from page 97

namic limit. With oil *A*, straight mineral oil, wear particles were detected coincident with the first signs of scoring. With oil *B*, some chemical wear was expected when loading shifted into the boundary zone. This undoubtedly was the case, but the magnitude was so small it couldn't be detected till higher loads were reached. And even then, wear rates were low compared to those met when visible scoring occurred.

Here's what all this adds up to: (1) When gears are lubricated with a straight mineral oil they operate in the thick-film zone until the score-load is reached. (2) Gears lubricated with EP oils also operate in the thick-film zone

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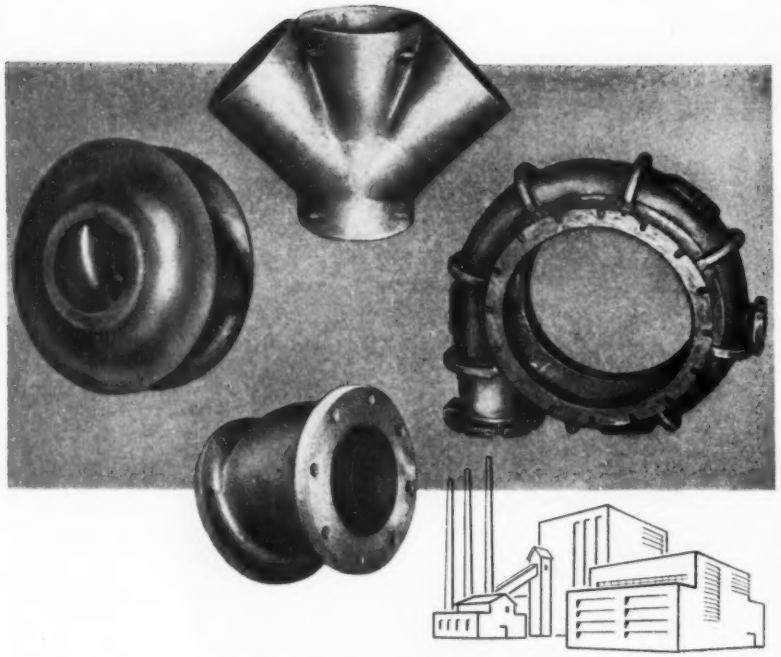

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Time after time, on installation after installation, reports show that ABK Metal is the most economical material for handling ash. The ultimate saving on replacement parts alone is appreciable. The saving in maintenance and shut-downs may be even higher.

Extended life of 4 or 5 to 1 is not unusual when ABK Metal replaces other iron castings—especially in those ash handling or disposal systems where the most severe type of abrasion is encountered. Don't let ABRASION steal your operating dollars . . . SPECIFY ABK METAL.

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RADIOACTIVE GEARS

Continued from page 214

up to the score limits of the base lube; loads above that point are carried by a chemically adsorbed film.

Many advantages go along with operation in the hydrodynamic zone; less friction, lighter pitting, practical elimination of wear. As a goal, gears and gear-lubricant design should be aimed toward the hydrodynamic, or thick-film, zone. Even though results thus far don't give the designer an equation into which he can slip values of gear and lubrication variables for a given transmission life, we are showing progress in that direction.

WITH OUR READERS

Continued from page 5

English and Continental practice, other suggestions are open to criticism.

In this country [England], convectors are invariably used in combination with high-temperature water, radiators never. As a further precaution, vertical pipes are lagged for a height of 6 ft above floor level.

The article is somewhat misleading inasmuch as it deals only with apparatus. In any conversion from steam to high-temperature water it would be necessary to install new piping, correctly sized, on the high-temperature-water side of the heaters and, possibly, to re-size the steam piping up to the heater. Process-plant and space-heating equipment may also need to be modified to suit the new medium.

The savings recorded are for high-temperature-water plants designed and installed as such. In Fig. 5 it would not be possible to achieve anything like a saving of 25 to 30% since the surplus water returned by way of the condensate return, as illustrated, would have no greater value than the equivalent weight of condensate from a steam plant.

The article states that by using cascade heaters it is possible to generate high-temperature water at any point in a steam plant, "making them feasible for jobs like space heating or for replacing worn-out steam systems." Surely, if the steam system is worn out, it would be preferable to start in the boilerhouse and install a new boiler adapted for high-temperature water. Shell boilers can be adapted as direct high-temperature water boilers at small cost.

Being somewhat conservative, we never claim a fuel saving in excess of 25%, and it is more than doubtful if this saving is possible with a conversion job. Further, there are pitfalls awaiting the advocate of conversion. The cleansing effect of high-temperature water frees the scale from existing steam plant and piping with the result that it becomes pitted. Valves in use for any length of time in a steam system will not hold up against high-temperature water and, generally speaking, are not suit-

Plastics plant saves $4,000 in one year!*

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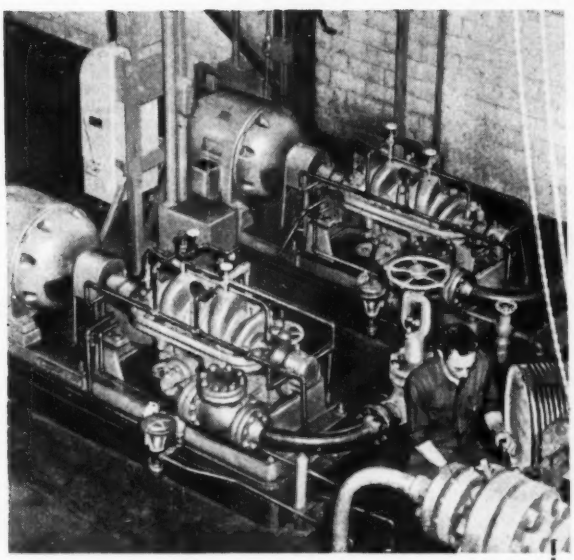

*Oxygen pitting was destroying the high pressure water pumps in General Electric's Coshocton, Ohio, laminated plastics plant. Rod packing had to be replaced every three days. Pure Oil's sales representative suggested adding PUROSOL No. 10 to the water. Result: damage stopped—and a saving of $4,000 a year.

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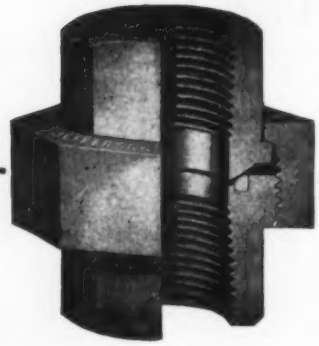

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WITH OUR READERS

Continued from page 216

able. Thus a conversion becomes increasingly costly as it progresses. This criticism, I may add, is not based on theory but experience.

Where a large supply of surplus steam is available, heaters and accumulators can be employed with advantage, but such a plant hardly falls under the heading of a conversion. Alternatively, where an existing steam plant can be so divided before leaving the boilerhouse as to permit of one section being converted to high-temperature water for space heating, the other section remaining on steam for processing, each section being controlled independently, the resultant savings may justify the expenditure. But, generally speaking, to justify claims for substantial savings by the use of high-temperature water, it must be selected at the medium in the design stage.

I trust I may be forgiven for criticizing your article adversely, but I do feel that American engineers have something to learn from English and Continental practice. The larger the plant, the more apparent are the advantages of high-temperature water, and since the system is not yet widely accepted in America, vast opportunities exist for developing new projects in preference to advocating conversions.

London, England — C L KEMPTON
Managing Director,
The Hobdell Engrg Co, Ltd

DIESEL-GOVERNORS

Continued from page 73

head centrifugal force and spring force. To reach a new balance, engine speed must change.

Suppose we reduce spring force by turning speed-adjusting screw, Fig. 5, to raise speeder plug and reduce spring compression. For the reduced spring force to balance flyweight centrifugal force in same vertical position of the flyweights as before, less centrifugal force is needed. This means less engine speed is needed. So reducing spring force causes engine to run at lower speed when carrying the same load as before.

Increasing spring force raises engine speed for the same load because more centrifugal force is needed to balance the spring.

Many governors use an independent spring for adjusting speed. Any spring that resists flyweight force affects engine speed at which the governor forces balance. The independent spring, usually outside the governor, is generally "softer" than the speeder spring to permit fine adjustment of speed. Future articles will discuss many other phases of engine governing.

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1¼	1	1	1	1½	1½	2	2	2½	2½	3	3
1½	1	1	1	1½	1½	2	2½	2½	3	3	3
2	1	1	1½	1½	2	2	2½	2½	3	3	3
2½	1	1	1½	1½	2	2½	2½	3	3	3	3½
3	1	1	1½	1½	2	2½	2½	3	3	3½	3½
3½	1	1	1½	2	2	2½	3	3	3½	4	4
4	1	1	1½	2	2	2½	3	3	3½	4	4
6	1½	1½	1½	2	2	2½	3	3	3½	4	4
8	1½	1½	1½	2	2	2½	3	3½	3½	4	4½
10	1½	1½	1½	2	2	2½	3	3½	4	4	4½
12	1½	1½	1½	2	2½	3	3	3½	4	4½	5
14	1½	1½	1½	2	2½	3	3	3½	4	4½	5
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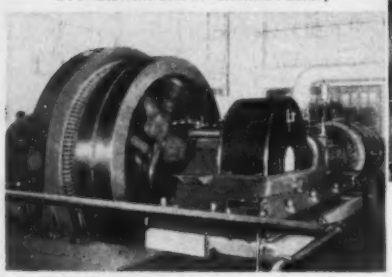

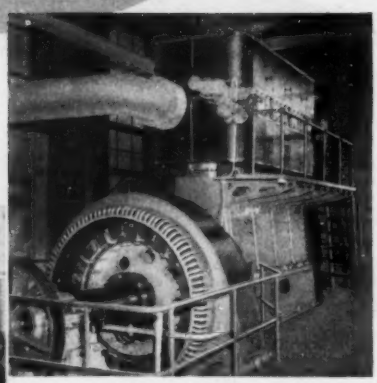

One of six 1250-kw. A-C four-cylinder "Universal Unaflow" engines, in furniture plants of one manufacturer.

The woodworking industries are varied . . . they include manufacturers of furniture, flooring, containers, shooks, plywood, toys, and novelties. But they all need power and light. They all need steam . . . for manufacturing processes . . . for space heating.

Many of them have found an economical solution for all these needs in a single installation . . . a Skinner "Universal Unaflow" Steam Engine power plant. They have, under their own roof and under their own control, a dependable, unfailing source of power for all needs; they have ample low-pressure steam for use in their manufacturing and for space heating . . . and they are saving thousands of dollars every year over the cost of providing these needs by any other means.

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More PLANT PROBLEMS

Begins on page 132

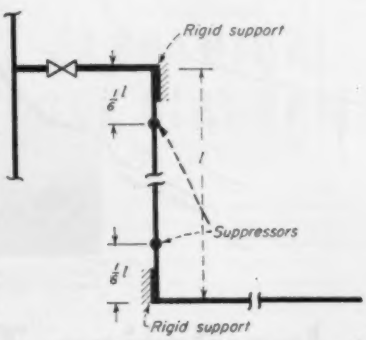
of these valves. Use 1-in. capped pipes 24 in. long just ahead of the valves as suppressors. These cushion shock, eliminate trouble.

Be sure cap is tightly threaded to suppressor and air is in it at all times. Reduce water flow through flush valves by adjusting cam setting or partially closing stop valves in the line. Pipe suppressors cure any remaining shock.

CH should consider using uniformly spaced supports for the piping. I prefer to have pipes well supported instead of hung loosely.

ART BELTON *Montreal, Can.*

NOTE PIPING LAYOUT. System is rigidly supported near its middle, loosely at other places. It resembles a seesaw. Any vibration at *B*, in the sketch on page



Suggested support arrangement

152, December POWER, travels over the rigid support and, along with resonant conditions, causes a large buildup at *A*.

First shock is probably caused by drop in line pressure when flush valves are opened. Best way to stop trouble is to alter piping structural support to change natural frequency of the system and prevent resonance.

One suitable alteration is rigid support for the 70-ft length of 2½-in. pipe at each end, using expansion joints if necessary. If hammering persists, install suppressors at points shown in sketch.

W H MILLER *Lancaster, Pa.*

SAME PROBLEM in our plant was licked by installing a type of flush valve that is noiseless. With it there is no line, throttling or closing noise. Neither is there any water hammer. We don't use suppressors with these valves.

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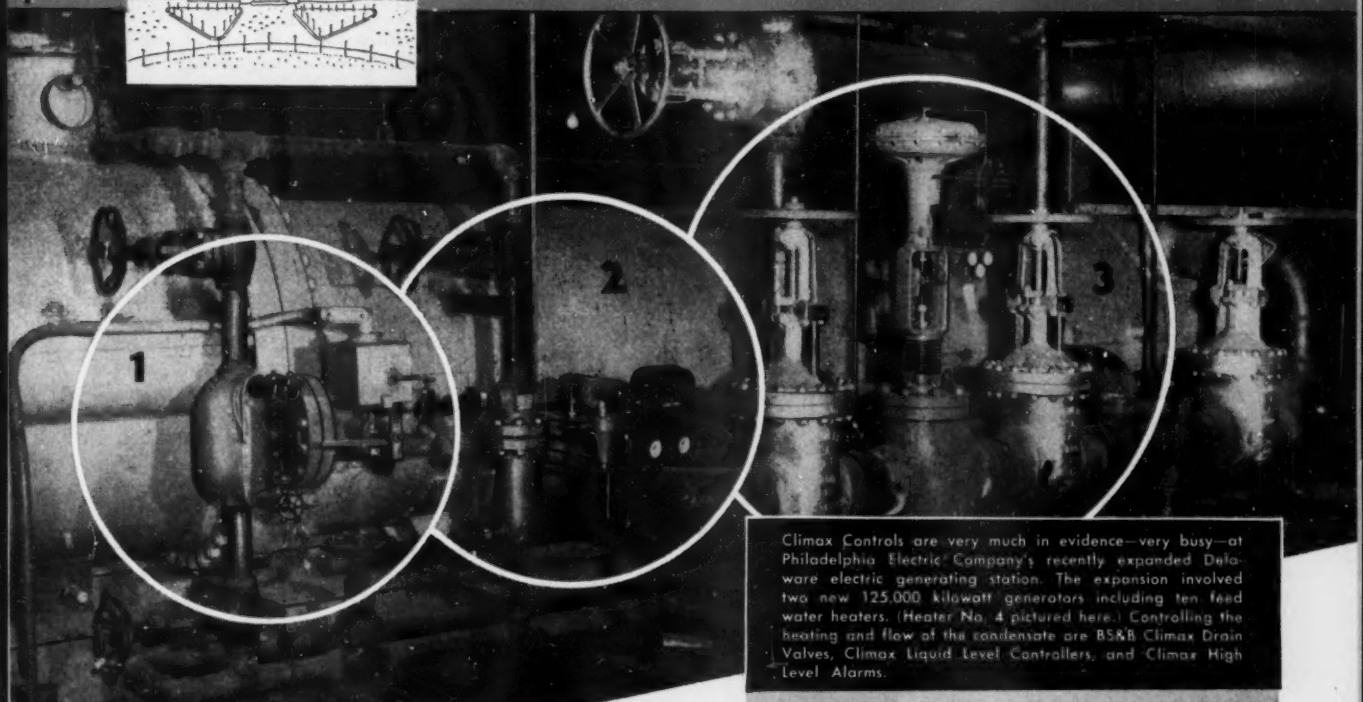

Climax Controls are very much in evidence—very busy—at Philadelphia Electric Company's recently expanded Delaware electric generating station. The expansion involved two new 125,000 kilowatt generators including ten feed water heaters. (Heater No. 4 pictured here.) Controlling the heating and flow of the condensate are BS&B Climax Drain Valves, Climax Liquid Level Controllers, and Climax High Level Alarms.

Climax Controls are precision instruments . . . completely relied upon by many precision minded industries. Over 12,000 different parts are manufactured for the assembly of various Climax Controls. Behind each part are years of instrument experience and knowledge and a particular *care* in fabrication. Every BS&B Climax Control is designed by men familiar with the industries using them. This protects your particular control application of pressures, temperatures, levels and flow.

1. BS&B Climax Control Type 46 Float Cage provides an excellent and economical method of controlling liquid levels through the operation of air pilots or electrical circuits, particularly where space is a factor. Float cages are constructed with cast steel bodies and housings for maximum pressures of either 500 or 1000 pounds.

2. The Torque Tube is the Heart of the BS&B Climax Liquid Level Controller. The ground cone head provides an absolute tight seal without using a gasket; also makes the tube easily adjusted. Climax is highly experienced in the design and application of torsion tubes. Inconel is used as standard torsion tube material because it satisfies the greater majority of services. Climax stocks other materials to meet certain corrosive conditions.

3. Here's the rugged, dependable BS&B Climax Diaphragm Control Valve. Typical of BS&B's versatility and ability to adapt equipment to needs and conditions is this Type 86 with finned section shown here. When temperatures above 450° F are encountered in the flowing medium, through any Type 86, it is advisable to insert this steel finned section between the valve body and the stuffing box assembly . . . thus insuring proper packing lubrication and cooler stuffing box operation.

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- to increase your air conditioning capacity
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Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

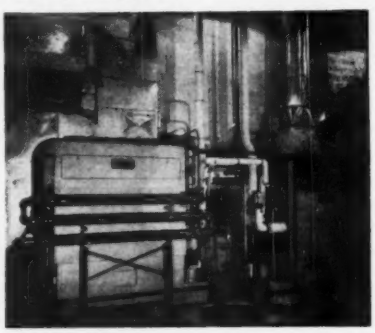
Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.



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More TECHNICAL BRIEFS

Begins on page 150

Fuels and Firing

Quick Starting of Large High-Pressure Boilers. *By Jefferson C Falkner, Consolidated Edison Co.*

In the near future the Consolidated Edison's generating stations will be faced with routine week-end 24 and 48 hour shutdowns of large, single unit, high pressure, high-temperature turbines and boilers. As a result of week-end load drop and the opening of the new Astoria Station—with heat rates approximately 20% better than that of existing plants—the annual number of cold starts on high pressure boilers will greatly increase. It is with this prospective situation in mind, together with a conviction that quick starting from cold of large high-pressure boilers, when properly handled, is less rigorous on the expanding boiler structure than present five to six hour starts, that this investigation was carried out.

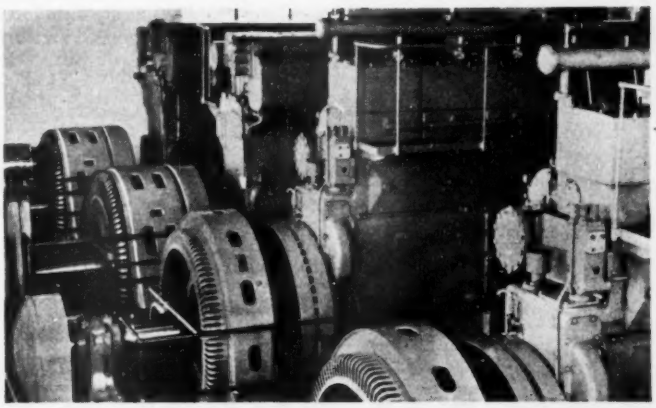
This paper shows by test results, that safe operating procedures can be developed to bring 1,000,000 lb steam per hour high-pressure high-temperature boilers equipped with high-pressure drop superheaters from a cold conditions to on-the-line in one to two hours. It discusses some of the operational techniques and fundamental concepts relative to such accelerated starts. It also presents data on the handling of both the topping and condensing turbines in connection with cold boiler starts.

Design and operation considerations of unit-system high-temperature boilers, prior to the work reported in this paper, have been concentrated on the range from 30% maximum to full output. Practically no performance data has been published to the author's knowledge in the range from zero to 30% maximum output. This is particularly true in the pre-output range which begins with light-off and ends with the synchronizing of the generator.

During the early part of the work reported herein, it was conceived that, following a week-end shutdown, a boiler, with its companion turbine, could be started in a total elapsed time of 60 minutes from light-off to on-the-bus. The proposed typical start or pre-output zone performance is shown graphically. However, as such an operation involves a rate of saturated steam temperature increase of 400 F to 500 F per hr—or four to five times as large as was the generally accepted practice prior to 1950—the reduction of starting time

Directions for ordering papers on p 152

"12,000 H.P. Hours per Gallon with Sinclair RUBILENE"



... says Leo D. Bradley, Manager
Western Michigan Electric Co-operative, Scottville, Michigan

"Our two Cooper Bessemer super-charged 1600 H.P. Model LS8T diesels deliver over 12,000 H.P. Hours per gallon of Sinclair RUBILENE H.D. Oil consumed," says Leo D. Bradley.

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Sinclair Products have been used since the generating station first went into operation – 12 years ago. The recommendations made by a Sinclair Lubrication Engineer at that time plus continuous counseling service and superior Sinclair Products have meant substantial savings for this co-operative.

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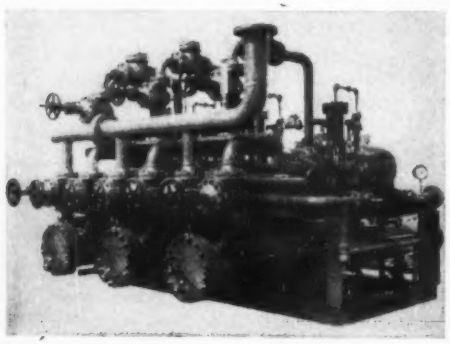

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More TECHNICAL BRIEFS

Begins on page 150

was brought about gradually. Successive shortenings were undertaken only after analysis of the data covering the previous start had demonstrated the soundness of the operation. The factors under close observation during these starts were: (1) Overheating of the superheater element metal in the gas passages. (2) Thermal stresses in the drum structure resulting from non-uniform heating of the drum by water and steam along its length, in the head, and across the drum wall. (3) Expansion of the entire boiler structure. *ASME Paper No. 52-A-120.*

Recent Developments in Slag Removal from Boiler Furnaces. *By W F Cantieri, Diamond Power Specialty Corp.*

Slag deposits encountered recently in certain high duty furnaces using a particularly low quality fuel have been almost impossible to remove with conventional deslaggers employing steam, air, water or combinations of the three. For over fifty years there have been intermittent reports of the use of shot guns with pellets or solid shot to remove troublesome slag from boiler heating surfaces. Results have varied from no success where build-up is general to fair to good where deposits are localized and otherwise inaccessible.

The cost of cartridges never could be brought within an acceptable range and compressed air was chosen as a projecting medium. The author describes the design considerations and finally the resulting pellet-feeding mechanism developed for use at the Ridgewood Station of the Commonwealth Edison Co for experimental services.

A number of tests have been run in this unit. Six pellet feeders were used to clean each side of the pendant radiant superheaters. Where the guns could be brought to bear on the superheater platens the surfaces were kept clean. But boiler construction and expansion limited the area the guns effectively covered. Several changes and several gun designs have grown out of this situation to give different pattern coverage. The author describes these guns as well as the different pellets employed. *ASME Paper No number.*

Application and Performance of Single Retort Underfeed Stokers. *By E C Webb and J E Atchison, Iron Fireman Mfg Co.*

The small single retort underfeed stoker offers the only commercial method of burning coal automatically on load cycles that include long banking periods or extended periods of very light load.

Directions for ordering papers on p 152

Here is a typical example of Mead-Morrison speed in handling coal.

The illustration shows a Mead-Morrison Travelling Unloading Tower with conveyor stacker boom at a large New England steam generating station. Its 4-ton coal grab bucket discharges 10,000-ton colliers at a breakdown rate in excess of 700 tons per hour.

There are over seventy-five unloaders of this type in operation along rivers and harbors from Maine to Florida.

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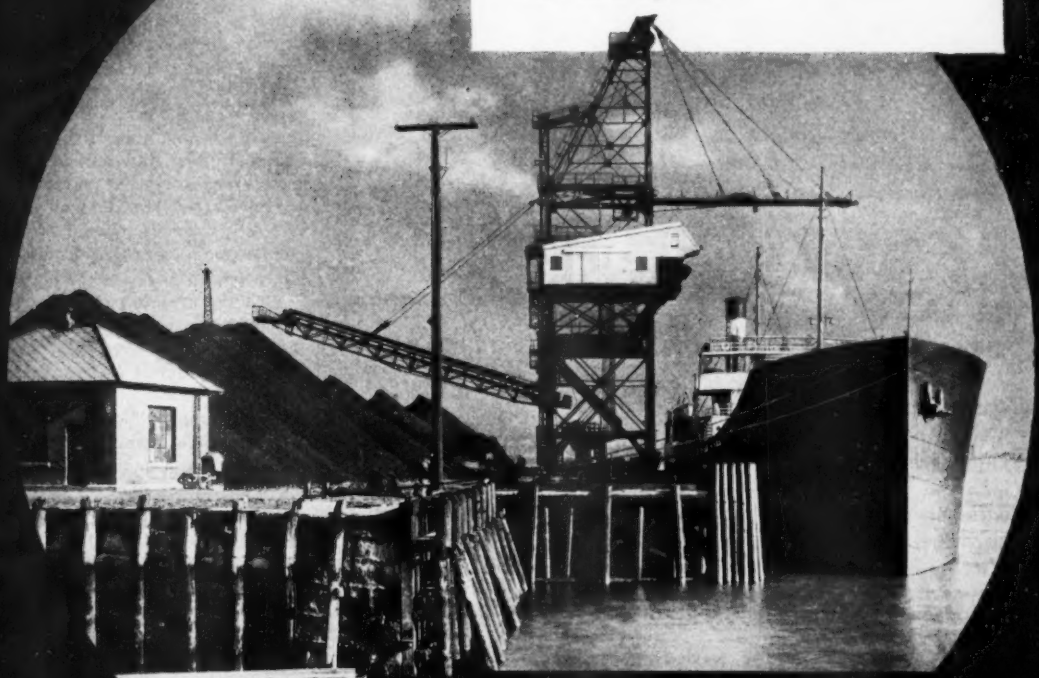

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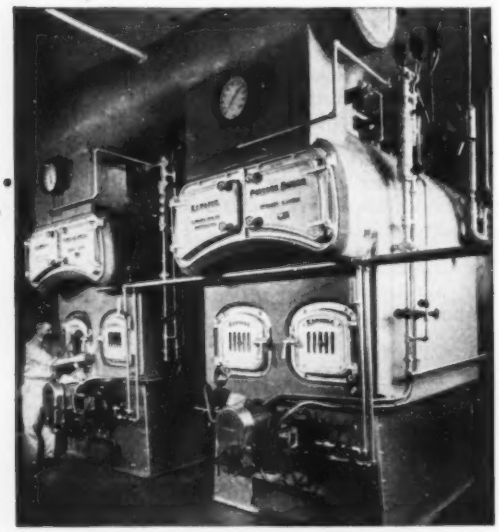

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The choice of Kewanee for the Stevens Memorial Hospital . . . selected as the "Hospital of the Month" by Modern Hospital Magazine . . . is in keeping with the trend of specifying Kewanee when dependable, economical heat or power is essential. And, it is significant that this building, erected with the finest materials and equipment throughout, was found in a U. S. Public Health Service study to have the *lowest construction cost per bed* of the 45 hospitals receiving federal aid during the period.

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More TECHNICAL BRIEFS

Begins on page 150

Many small single unit plants used primarily for space heating have this type of load cycle. The authors believe a better understanding of the operating characteristics of stokers should help in specifying or purchasing combustion equipment for this class of plant.

A fundamental characteristic of the small underfeed stoker is its ability to (1) maintain ignition over a relatively small portion of the grate area (that is, in the retort zone), (2) automatically expand the active burning area to handle full firing rate. It is very important to maintain accurate control of the air-fuel ratio if high combustion efficiencies are to be maintained. Moreover, with widely fluctuating loads, the performance of the equipment used for metering air flow becomes of even greater importance.

In addition to accurate control of the air flow rates, the general area of air admission to the fuel bed requires careful consideration. For best results, a proper balance must be maintained between the air admission zone (often referred to as the active grate area) and the overall plan area of the combustion chamber. The optimum proportion of these areas is affected materially by the load cycle, the peak load on the unit in relation to the length and width of the combustion chamber and the burning characteristics of the coal to be used.

Under certain operating conditions objectionable smoke may be produced immediately following the "On" period of an intermittently (sometimes referred to as the "On-Off" type of operation) operated unit.

If the stoker firing rate is modulated through a sufficiently wide range to meet the major changes in output requirements (instead of the "full on or off" method of control), off period smoking may be eliminated without the use of overfire jets. Otherwise jets are necessary. *ASME Paper No. 52-A-67.*

Application of Single Retort Underfeed Stokers. *By D J Mosshart, Westinghouse Elec Corp.*

In numbers, the single retort underfeed stoker continues as an important factor in the field of coal burning equipment because of low overall cost of installation. Improvement in performance is possible at an increase in cost. Greater care in working out details of application and in establishing control of operation will pay good dividends in over-all economy and abatement of smoke and dust emission.

Available statistics for class 5 stokers, those with capacity over 1200 lbs fuel

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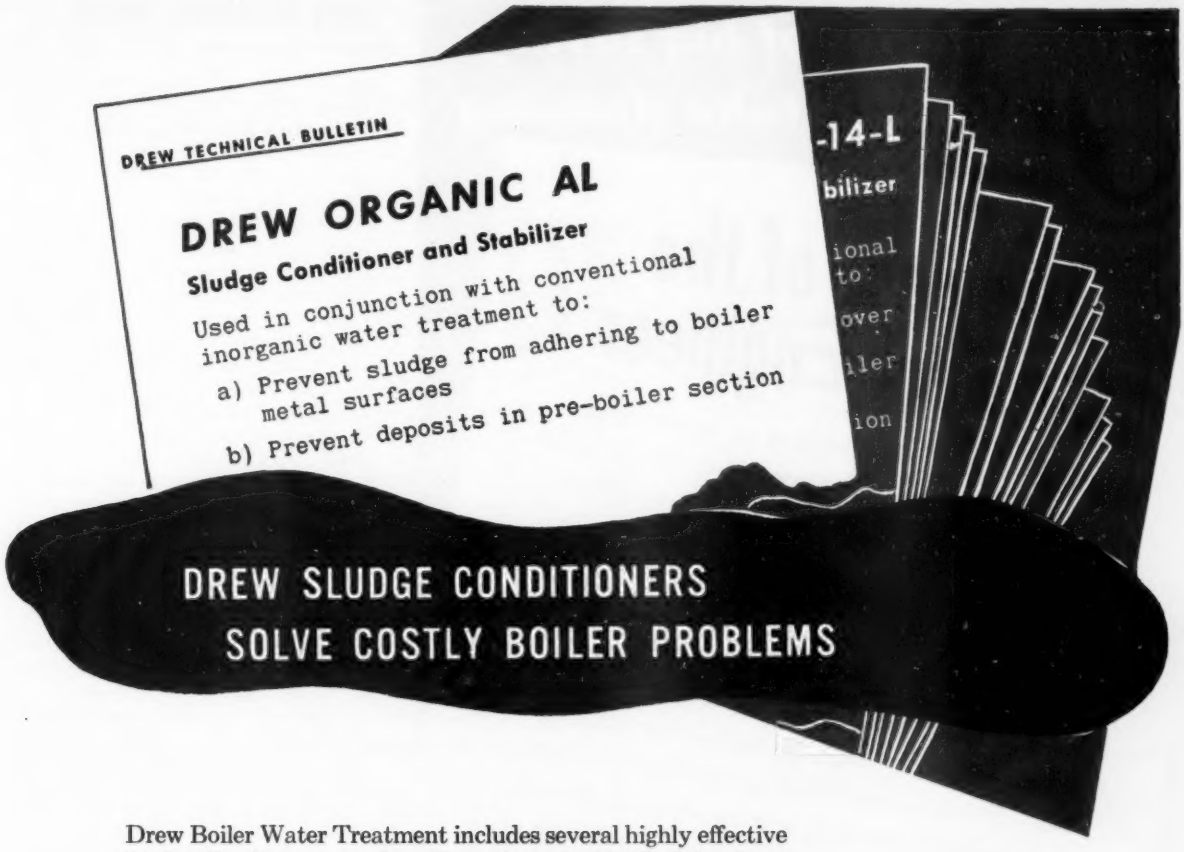

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More TECHNICAL BRIEFS

Begins on page 150

per hr, for the years 1950-51 show about 20% of all stokers sold to be single retort underfeeds. Although they represent only 10% of the fuel burning capacity sold, they constitute 20% of the selections made.

For the author's company in three years, 1949-51, inclusive, 18% of single retort sales were conversion or replacement units installed in old boilers with refractory furnaces. Of the units sold for installation in new boilers, 86% were installed in standardized type boilers with integral waterwalls, 11% in refractory furnaces and only 3% in "custom designed" furnaces with water walls. Very obviously dominant selection of boiler equipment was based on low first cost, but water cooling of the furnaces was given prime consideration. Low price is contingent on little or no deviation from the manufacturer's standard design proportions; i.e., there is little, if any, latitude for increase of furnace height, application of special shapes of walls, etc, to favor a particular type of combustion equipment.

Study of the entire collection of standardized boiler applications with regard to minimum flame travel from grate to convection surfaces revealed that only 20% of the total units would enable application of spreader type stokers satisfactory to the author's Company. The remaining 80% provide adequate flame travel for single retort stokers. Yet these units give satisfactory service.

But to provide for maximum all around performance with available conventional designs of boilers, certain observations are offered, drawn from experience:

(1) Widest latitude in the purchase of coal comes from installing the moving grate type of stoker in all widths down to the minimum in which this type is available, and by providing a water-cooled furnace, at least in the side-walls.

(2) Operation with the more or less traditional thick fuel bed is, and always was, a wrong approach to good performance. Performance will be best, maintenance least, fuel flexibility greatest, when operation is maintained with the thinnest firebed which will support combustion with excess air in the range of 30 to 40%. With present day attitude of operating personnel, such operation is most readily obtainable by the application of careful adjustment and maintenance of the steamflow-airflow type of automatic combustion control.

(3) Cinder and fly ash carryover is relatively low with single retort stokers.

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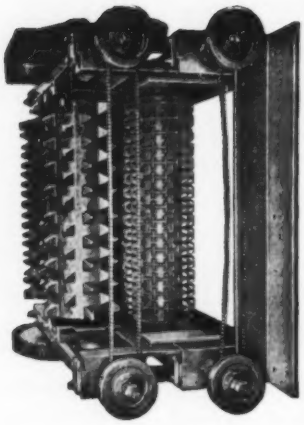

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More TECHNICAL BRIEFS

Begins on page 150

but there is some carryover to be considered. Most boilers, especially the standardized types, are in themselves fairly effective cinder traps, yet occasionally there are complaints of cinder emission from them. In practically all such cases, the reason is lack of provision for proper removal of the trapped cinder; "removal" being accomplished by opening chamber doors or hopper gates under draft and hoeing or dropping out some of the cinder while the rest is swept away and up the stack by in-rushing air. Elimination of this nuisance can be effected by application of air operated cinder ejectors, similar to those employed with spreader stokers, arranged to discharge the cinder to the ashpit below the dump grates.

(4) Secondary or overfire air can be used advantageously to a very limited extent. The older low pressure devices for secondary air injection were of very questionable value and have generally been abandoned. *ASME Paper No. 52-A-103.*

Turbulent Suspension Burning of Wet Wood, Bark and Other Fuels. *By Otto de Lorenzi, Combustion Engineering-Superheater, Inc.*

Turbulent suspension burning may be defined as the principle of showering particles of solid fuel downward from some considerable height in a tower-like furnace, through relatively large quantities of highly turbulent gas and overfire air to effect: (a) flash drying; (b) partial or complete devolatilization; (c) ignition of residual fuel constituents; and (d) uniform distribution of the residual fuel to the grate surface in the lower furnace zone where combustion is completed through the use of reduced quantities of undergrate air.

Fuel distributors in furnaces employing the principle of real turbulent suspension burning are at an elevation of from 12 to 20 ft above grate level. Overfire-air jets go in the furnace corners between feeder and grate levels. With this arrangement it becomes possible to use large fuel particles, because they are spun around in flight by the overfire-air streams and thus retained in the rising column of burning gas for a greater length of time before coming to rest at grate level. It is this increased time of flight through the hottest furnace zone that provides for flash drying, partial or complete devolatilization, and ignition of residual fuel constituents. Slug feeding produces no noticeable change at fuel bed level, and consequently there are no adverse ef-

Directions for ordering papers on p 152

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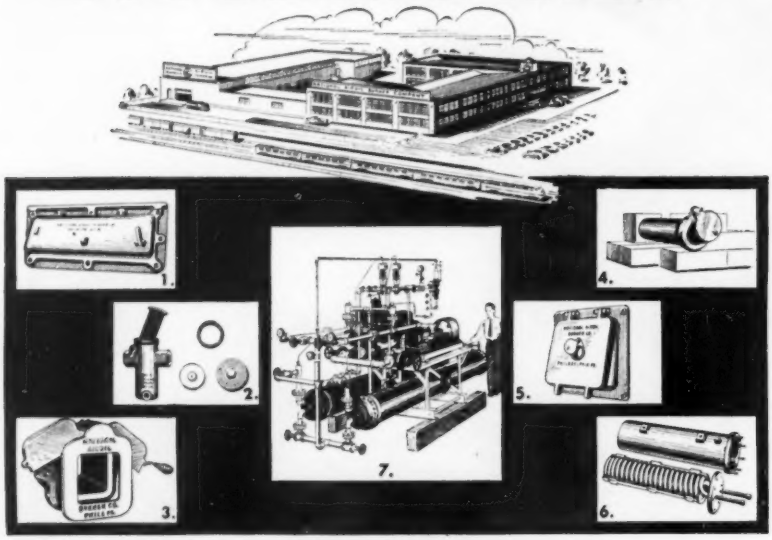

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More TECHNICAL BRIEFS

Begins on page 150

fects on operating results.

Design and operating characteristics of conventional spreader stoker installations differ in many ways from the foregoing. Distributor location in the furnace frontwall is at an elevation of from 3 to 4 ft above grate level. Consequently, flight of fuel from distributor to grate is quickly completed over a relatively short and flat trajectory. Of course, some of the smaller, lighter particles will be carried upward by the gas stream and thus never reach the grate. The major portion of the feed, however, has hardly started through the drying and devolatilization stages before it reaches the fuel bed. Thus a greater part of the drying and practically all of the combustion process actually takes place after the fuel comes to rest on the grate. This characteristic of conventional spreader installations makes it necessary to supply practically all air for combustion through the grate and thereby limits the amount which may be used overfire for producing furnace turbulence or for effecting flyash return. Furthermore, if there is any erratic or slug feeding, particularly where moisture content of the fuel is high, partial quenching of the bed will immediately follow periods of heavy feed. During the interval between slugs the fuel bed will gradually brighten as drying of the fresh charge progresses. Semi-slow motion pictures will show this action, which is not always perceptible during normal observation, because its frequency may be too rapid. Operating results under these conditions, however, are usually somewhat less favorable than those obtained with controlled feed.

Fuel size, regardless of the method used for firing, has considerable effect on furnace performance. Generally any wood refuse which can be handled by the conveyor system can also be used for spreader stokers or cone burning. Control of operating results, however, will favor those installations where oversize fuel is hogged and feed size is held as constant as reasonably possible.

During the past several years there have been placed in service an increasing number of spreader stoker installations which use some form of wood or cellulose fiber refuse as primary fuel. *ASME Paper No. 52-A-104.*

Furnace Heat Absorption in a Spreader-Stoker-Fired Steam Generator. *By James W Myers and Richard C Corey, Bureau of Mines.*

An investigation was conducted to de-

Directions for ordering papers on p 152

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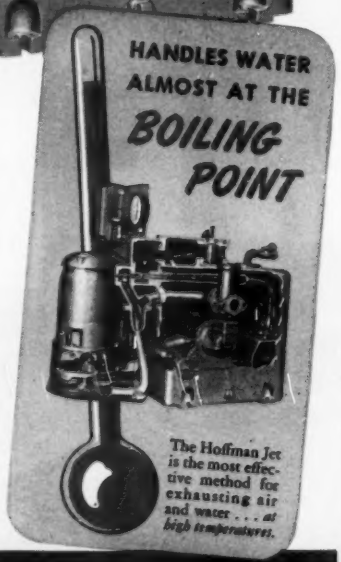
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More TECHNICAL BRIEFS

Begins on page 150

termine the furnace heat-absorption efficiency and the distribution of heat transfer on the furnace walls of boiler No. 2 at the Whiting Plant of the Carbide and Carbon Chemicals Company, Whiting, Indiana. The unit is a two-drum boiler rated at 165,000 lb steam per hr, 915 psig and 740 F, and fired with a spreader stoker on a front-discharge traveling grate. This is the fifth in a series of comprehensive investigations of heat transfer in steam-boiler furnaces by the Special Research Committee on Furnace Performance Factors of the ASME. Three of the former investigations were on pulverized-coal-fired units and one was on a natural-gas-fired furnace. The present investigation is the first concerned with spreader-stoker firing.

The furnace heat absorption was determined from the temperature and composition of the furnace exit gases in fifteen tests on the steam generator above. The effect on furnace heat-absorption efficiency is shown for variation of (a) the heat available in the furnace, (b) the excess air, (c) the percentage of combustion air admitted over the fuel bed, and (d) the condition of the furnace walls with respect to ash deposits. Detailed data on the distribution of gas temperature and of excess air in the furnace are presented. The experimental values for the furnace heat-absorption efficiency did not compare favorably with values calculated by either the Stefan-Boltz Mann or the Wohlenberg equations. There is evidence, however, that the performance of a spreader-stoker-fired furnace might be predicted by the Wohlenberg equation if it were modified to allow for heat transfer resulting from a combination of suspension and fixed-bed burning. *ASME Paper No. 52-A-143.*

Furnace Heat Absorption in a Spreader Stoker Fired Steam Generator, Part II. *By Frank G Feeley, Jr, Carbide and Carbon Chemical Co and Earle C Miller, Riley Stoker Corp.*

This report covers the testing of a spreader stoker fired furnace and is in addition to the Myers, Corey Paper, Part I, reported above. So far as possible this test work followed the technique developed on the previous tests. Furnace heat absorption was determined by furnace heat balance in Part I and here, in Part II it is found by measuring the surface temperature of the exposed side of the furnace tubes.

The procedure required a series of tests to determine the stack dust load-

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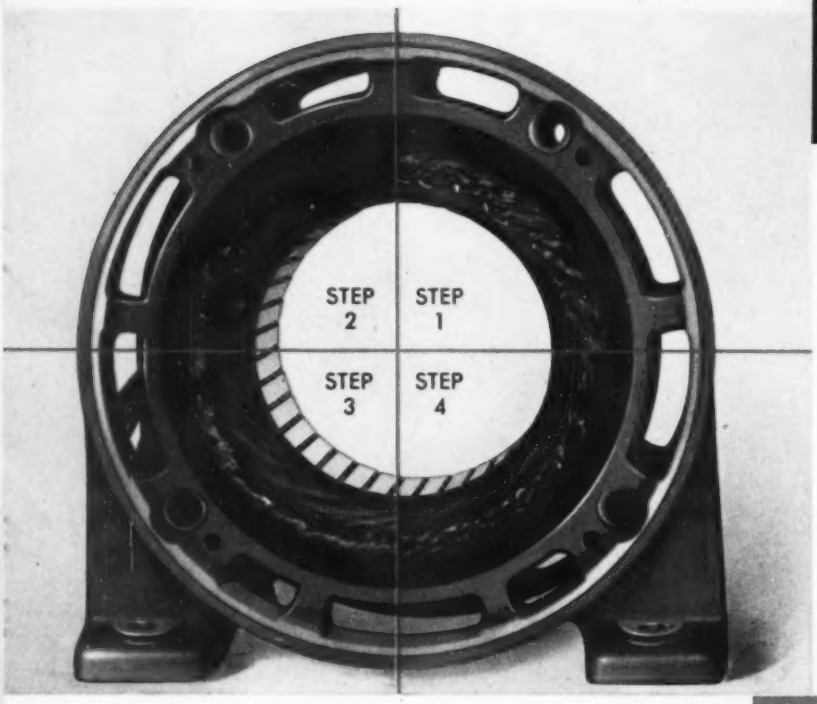

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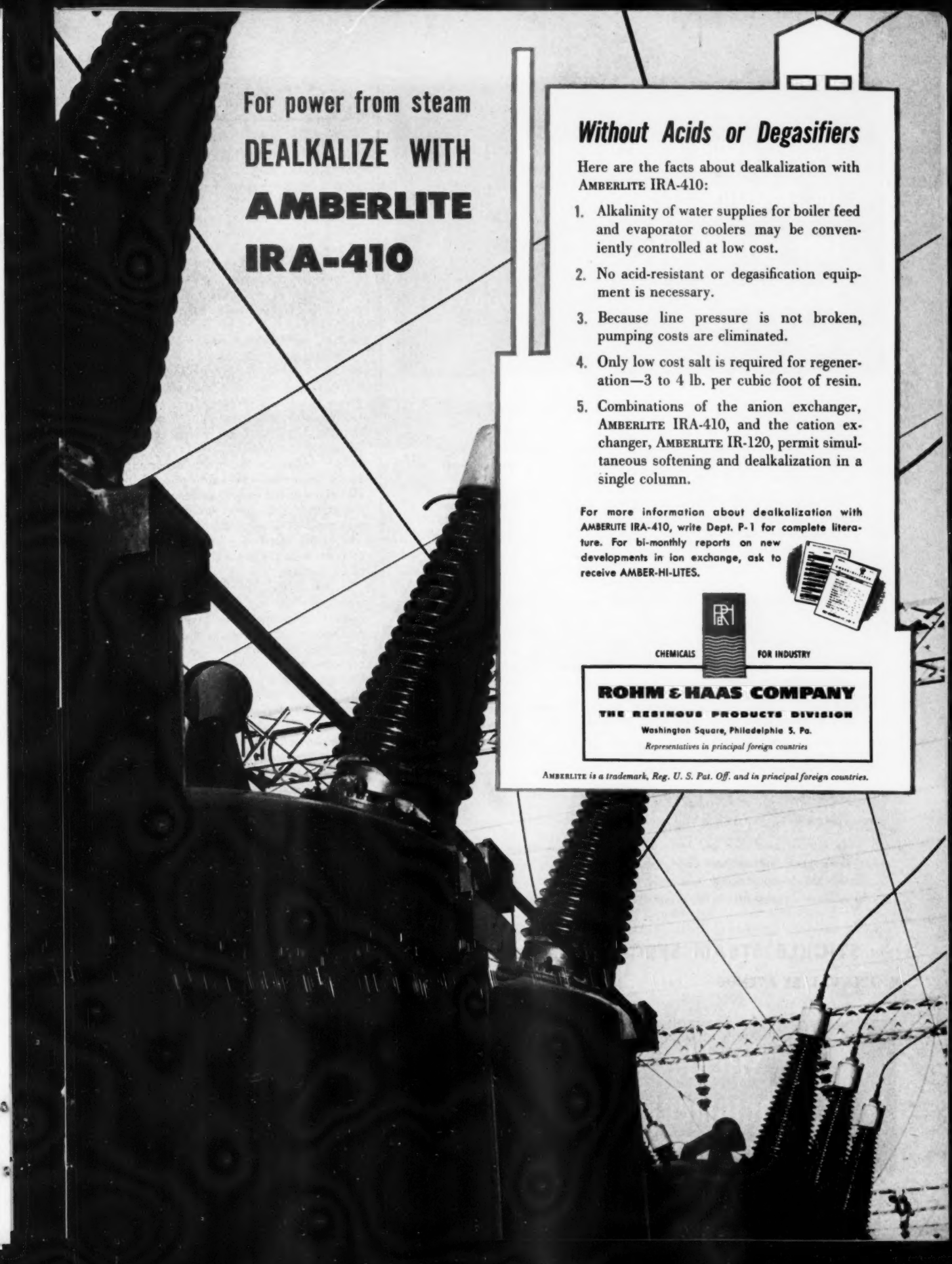

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More TECHNICAL BRIEFS

Begins on page 150

ing. Because of the many questions received concerning the results of this portion of the test work the data has been included.

The isothermal diagrams and results shown in various graphs reveal a pattern of heat absorption for the furnace envelope. The accuracy of tube surface temperature determinations is always subject to question due to localized ash deposits, irregularities in thermocouple application and other less tangible factors. The system is, however, sufficiently accurate to produce reliable data on the factors effecting relative heat-absorption of the various furnace walls. These factors are: rating, excess air for combustion, and slag-ash coverage. Overfire air, and flame shape are of secondary importance.

The rating is the most important factor in overall heat-absorption but elevations of the various surfaces above the grate has the greatest influence on relative heat absorption of the walls. The rating has less effect on heat-absorption near the grate than at the top of the furnace.

At all loads heat-absorption in the walls decreases rapidly as the distance from the grate increases. Excess air for combustion affects average heat-absorption at all loads but has little effect on heat-absorption near the grate. The slag-ash pattern is more stable and of less influence in spreader stoker firing than in the pulverized coal fired test units. Overfire air, when used within the limits of these tests has negligible effect on furnace heat-absorption. *ASME Paper No. 52-A-142.*

Industrial Experience in Fly Ash Collection. *By B S Norling, E I du Pont de Nemours & Co, Inc.*

Until recent years, the atmosphere was considered a natural means of waste disposal. Almost without exception the furnace gases from homes, schools, small and large industries alike, discharged their furnace gases with all the products of combustion into the atmosphere. With the increase in population and concentration of industry, this practice could not be continued without deleterious effects. This paper discusses the problems involved, citing as an example the installation of fly-ash collectors and the disposal system for a large existing industrial plant in an area where a nuisance was said to exist.

A survey was made to determine the plant's contribution to the conditions causing the nuisance. Tests were run

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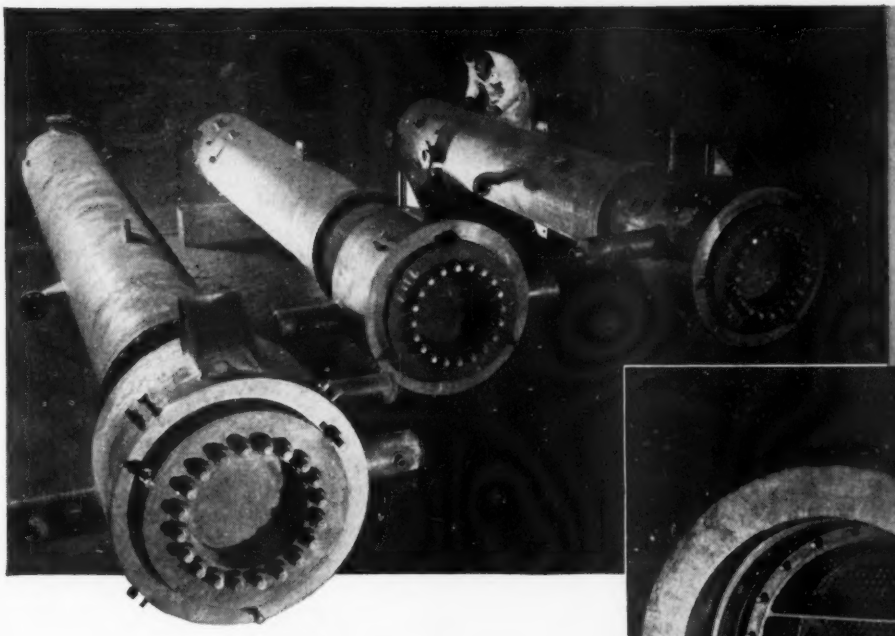

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Here, at A. O. Smith, is a matchless combination of designing, engineering and fabricating skills, experience and equipment on which to draw in solving any feed water heater and heat-exchanger problem. Dedicated to the search and development of better techniques, A. O. Smith engineers have created many "firsts" in the pressure-vessel and heat exchanger fields.

For high-pressure service, the exclusive A. O. Smith MULTI-LAYER process was conceived and designed for constructing thick-walled vessels and exchangers. For reliable corrosive service at minimum cost, another exclusive was developed: the SMITHlining process of permanently bonding stainless or other materials to carbon plate.

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Proof of performance is obtained with A. O. Smith's own testing procedures. Full-scale vessels are tested to destruction at isolated test stations where pressures up to 50,000 psi can be applied. Materials are tested prior to fabrication in the company's chemical, physical, metallurgical and spectrographic laboratories.

Problems are resolved by research groups whose combined experience and accumulated data are without parallel. Closely associated are the experts in tool and fixture design who have their own unexcelled facilities.

• Three high-pressure feed water heaters are shown in the upper illustration. They are designed for 2400 psi on the tube side and have modified Bridgeman closures for channel covers.

• The lower illustration is a view of one of the above feed water heaters prior to completion, showing detail of channel construction. Tube sheet was drilled by A. O. Smith high-precision method to a degree of perfection far above accepted standards, to insure against leakage.

• • •

For high-pressure or conventional feed water heaters and heat exchangers, whether for chemical, petro-chemical, petroleum refining or power applications, A. O. Smith is your best source. Consult the nearest district office listed below, or write: A. O. Smith Corporation, Process Equipment Division, Dept. P-353, Milwaukee 1, Wisconsin.

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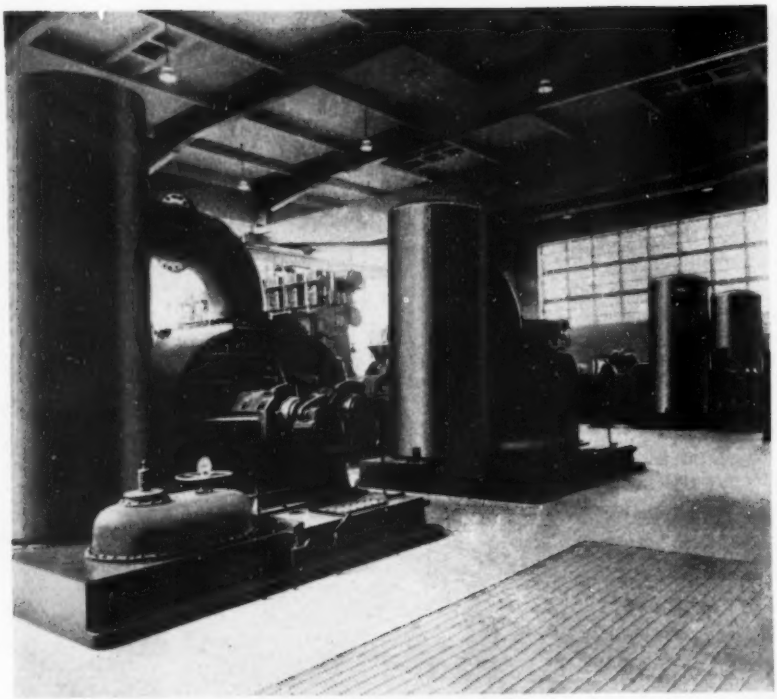

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More TECHNICAL BRIEFS

Begins on page 150

to determine the fly-ash emission rates from the power house stacks. At the same time, the downwind concentration of fly ash at ground level was also measured. The fly ash concentration at ground level was found to be from 2 to 7 times in excess of values normally considered to be acceptable. The decision was then made to proceed with the installation of collectors.

In the power house there are eight pulverized coal-fired boilers. Three of the boilers have a nominal steam-generating capacity of 80,000 lb per hr while the other five are rated at 130,000 lb. The steam pressure is 450 psig with a total temperature of approximately 700 F. The peak steaming rate is 930,000 lb per hr and the average is approximately 750,000 lb per hr. This plant is in continuous operation and load variations are due to seasonal and production changes. The coal burned is obtained from a wide variety of mines from Virginia, West Virginia and Pennsylvania.

The ash content of the coal varies from 6% to 12% with the average around 9%. The average ash content has been slowly rising. Of the ash in the coal, approximately 15% drops into the furnace bottom or hoppers and the remaining 85% is carried through the boiler and out the stack as fly ash with the flue gas. The carbon content of the fly ash varies quite widely. Because samples are taken at irregular intervals, a true average carbon content is not available. It has been estimated to be in the neighborhood of 20%. The carbon in the ash not only increases the quantity of fly ash, but it decreases the bulk density. Random samples taken from the collector hopper indicates that the bulk density of the ash with 20% carbon varies between 30 and 35 lb per cu ft when poured into a container as it does in a collector hopper. Tapping or shaking the container packs the ash and thus reduces the volume and increases the bulk density.

Directions for ordering papers on p 152

The State of California's plan for a $1.2 billion development of the water resources of the Feather River has made news on two fronts. Most important was the news from Washington that the Department of Interior will not oppose the state's plans. Meanwhile, in Sacramento the California Water Project Authority voted to ask the state legislature for an additional $750,000 to further the completion of investigations of the project. The legislature already has approved $800,000 for investigative work for the current fiscal year.

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Walworth-made valves, pipe fittings, and pipe wrenches, total approximately 50,000 items—all sold through distributors in principal centers throughout the world.

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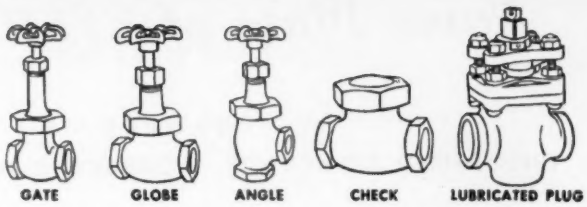

Bronze valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 225P Bronze Globe Valve. This valve has a working steam pressure rating of 350 psi at 550F (1,000 psi non-shock cold water, oil, and gas pressure). It features a renewable, plug type, stainless steel seat and disc, heat treated to 500 Brinell hardness.

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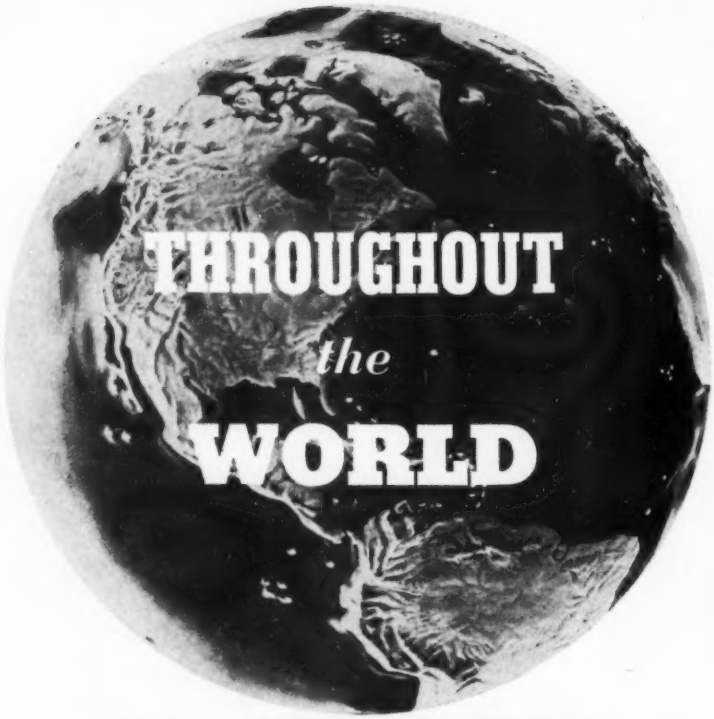

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More POWER NEWS

Begins on page 148

Boiler Ratings Come In For Spirited Debate

At a recent Chicago sectional meeting of the American Society of Heating and Ventilating Engineers, the controversial problem of what's the correct way to rate boilers was aired in debate form. The subject was narrowed down to a discussion of the relative merits of the Packaged Steam Generator manufacturers' approach against that of the Steel Boiler Institute.

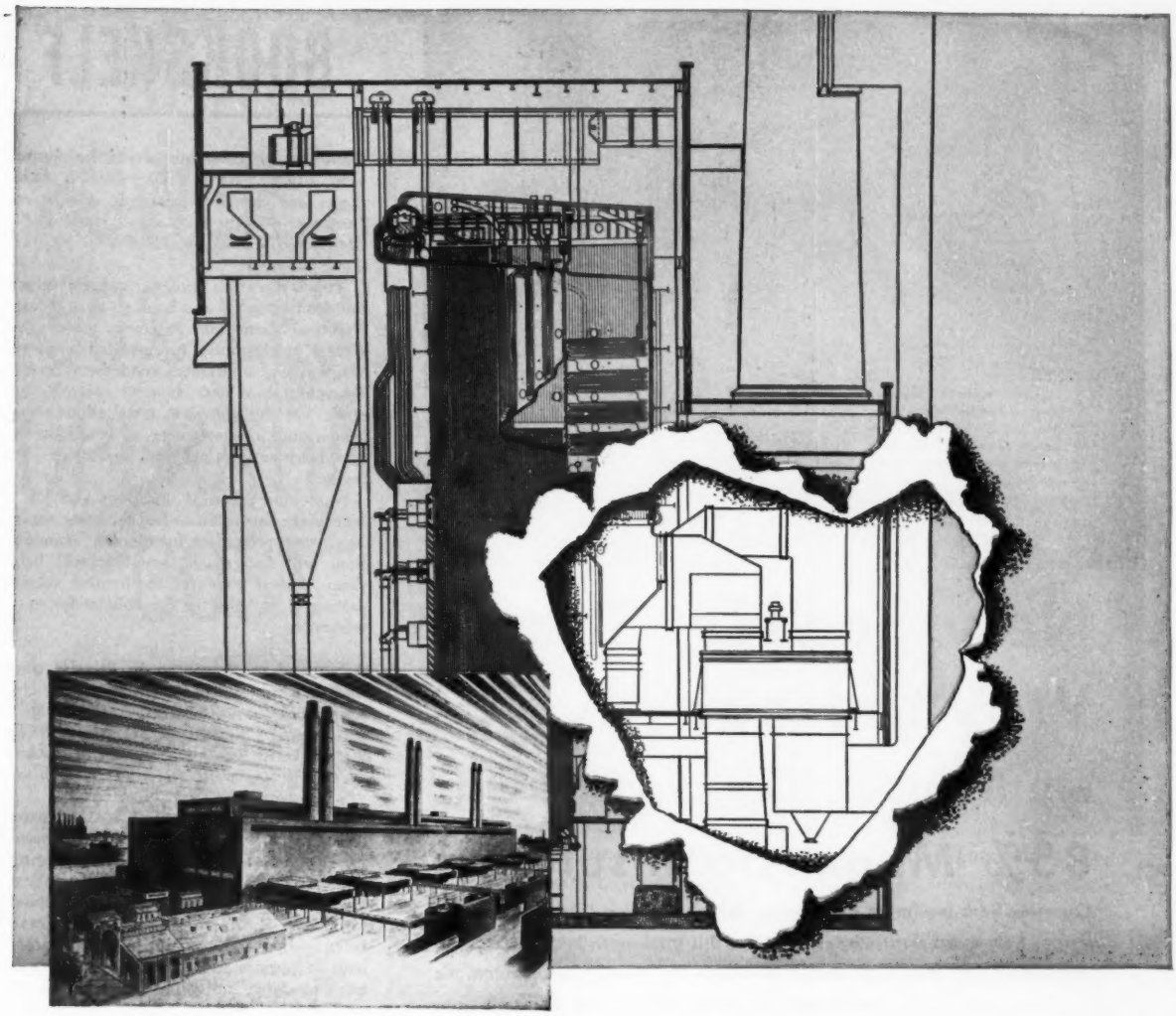
C V Anderson, chief engineer of the Cleaver Brooks Co, was champion of the packaged steam generator cause and J R Collette, vice president, Fitzgibbons Boiler Co, of the Steel Boiler Institute.

Anderson maintained that peak load ratings based on 5 to 6 sq ft of heating surface for boiler hp proved highly satisfactory for the packaged boiler purchaser in selecting his equipment. With the knowledge that ratings are based on peak output the engineer selecting the generator can go ahead and make proper allowances for piping losses, pickup, future plant or building changes, expansion.

Collette countered with the argument that SBI ratings—8.2 sq ft of heating surface for boiler hp—provide a much needed safety factor. A boiler selected on SBI ratings can handle 150% of the rated load and operate continuously at 125% of rating. The SBI code, said Collette, has been time tested for 20 years and has proved most suitable.

Four factors dictate choosing a location for what could be the world's first commercial atomic energy power plant. That was the statement in Las Vegas Oct. 13 before a U. S. Senate sub-committee by Dr Lawrence R Hafstad, director of reactor development for the atomic energy commission. Those four factors, he said, are (1) price of electric power which could be sold; (2) the construction cost index; (3) availability of cooling water and (4) strategic safety in the event of enemy attack. Dr. Hafstad admitted that a site near Eureka, Nev., was "high on the list" of possible locations.

As for the ultimate commercial energy possibilities of such a reactor, they are enormous. Dr. Hafstad said that one pound of fissionable uranium metal produced as much energy as 2,600,000 lb of coal. Or, one pound of the ore could get the same energy results as 1300 tons of fuel oil. He said, in using the Eureka areas as an example, that it would be much cheaper to truck in a pound of uranium ore than to haul diesel fuel from long distances. And the atomic expert implied that atomic produced energy in the mining industry might cut in half the present cost of producing power with diesel engines.



Reheat Boilers at Astoria Station of the Consolidated Edison Co. of New York, Inc.

equipped with

LJUNGSTROM AIR PREHEATERS

As part of its immense expansion program, Consolidated Edison Company of New York will place its new Astoria Station in service in the early spring of 1953. Ultimately to have a capacity of 1,000,000 kilowatts, the station's first unit will generate 180,000 kilowatts, with a duplicate unit to follow in a few months.

Astoria Station was designed by the staff of Consolidated Edison, and is being built by various contractors. Its 160,000-kw (nameplate rating) turbine-generators each will be powered by a Babcock & Wilcox reheat boiler, rated at a continuous capacity, coal fired, of 1,200,000 pounds of steam per hour at 1850 psi and 1000 F, reheated to 1000 F.

Each boiler at this huge new station will be serviced by two Ljungstrom Air Preheaters, which will preheat incoming air to approximately 560 F, and cool exit gases to 250 F.

Once again—as is the case with millions of kilowatts of generating capacity all over the country—the Ljungstrom Air Preheater was selected for high-performance steam generating equipment. The unanimity with which the Ljungstrom has been chosen—by utilities . . . by industry . . . by consultants . . . by boiler manufacturers—for efficient steam generating units can be your guide, too, to steam generation with top fuel economy.

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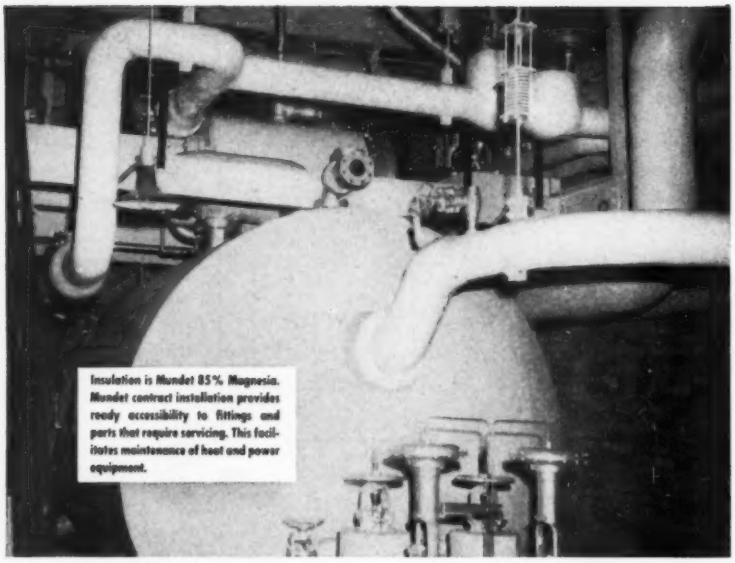
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BOOKSHELF

Commercial and Industrial Refrigeration. *(1952). By C Wesley Nelson, head, steam and diesel engrg dept, Wentworth Institute. 467 pp, 6x9, illust, cloth, $7.00. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This is a text for students and servicemen and isn't intended as a book on pure theory. Practical throughout, it covers basic principles, refrigerants, compression systems, evaporators, compressors, condensers, receivers, control valves, motors, controls, installation, multiple-unit installations, low-temperature jobs, servicing, air conditioning, and load calculations and equipment selection.

Numerous practical questions and problems make this volume ideal for home study. Engineers preparing for license examinations will find much here that will help them. Safety code for mechanical refrigeration is included in the volume for easy reference.

Advanced Mathematics in Physics and Engineering. *(1953 First edition). By Arthur Bronwell, professor of electrical engrg, Northwestern University, Secretary ASEE. 6½x9¼, 475 pp, many illus and tables, $6.00. McGraw-Hill Book Co, 330 West 42nd Street, New York 36, N. Y.*

The fundamental physical laws in many of the more important areas are expressed in very general form. From these spring the development of vast areas of applications. The book shows how the fundamental formulas simplify to special cases. These serve as the starting point in solving problems in physics and engineering. There is an underlying unity in the methods of mathematical analysis used in the various fields of physics and engineering.

Mathematical topics include: infinite series; Fourier series and integral; ordinary differential equations; partial differentiation; Lagrange's equations; Hamilton's vector analysis; functions of a complex variable; Laplace transformations.

The book features a chapter on unified treatment of the solutions of a broad classification of linear partial differential equations. These include wave equation with and without energy dissipation, heat flow and chemical diffusion, and others. These equations underlie such fields as fluid dynamics, heat flow, vibration in systems with distributed elements, electromagnetic theory and so forth. Solutions of the differential equations in various coordinate systems are obtained in the form of characteristic functions. The proper characteristic functions are then selected for a given static or dynamic problem.

Heat Transfer Phenomena. *(1952 First edition). By R C L Bosworth (Australia). 5½x9, 211 pp, 41 fig., 13 tables, $6. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

This book represents an expansion of a paper originally presented before the Australian branch of the Institute of

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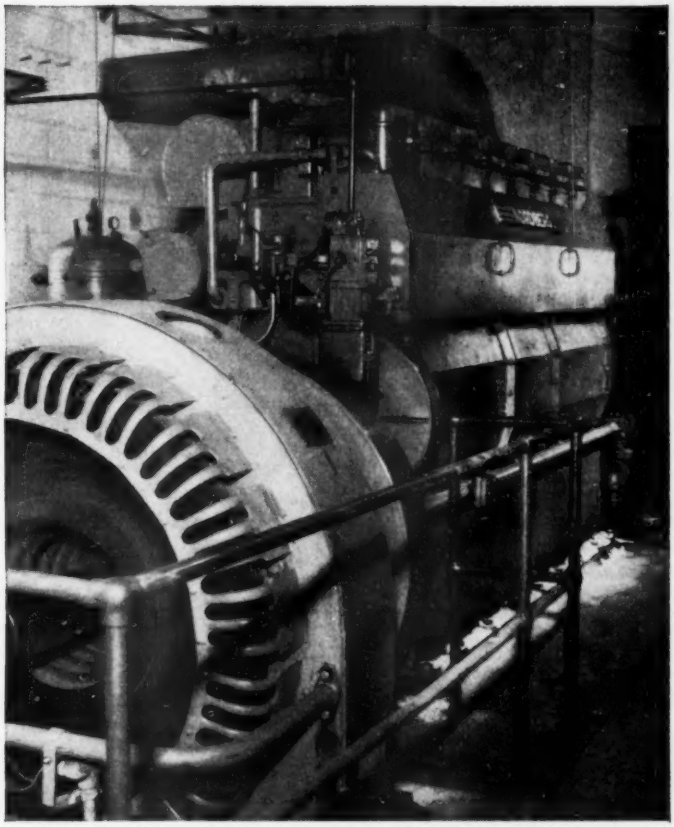

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P153

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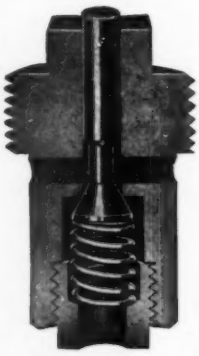

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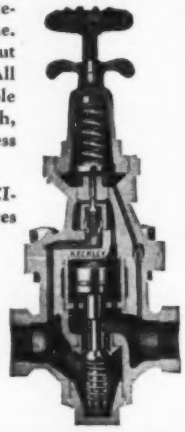

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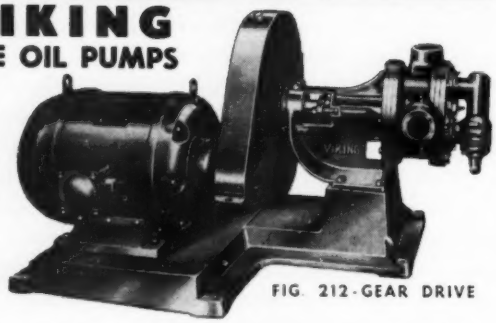

FIG. 212-GEAR DRIVE

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More BOOKSHELF

Begins on page 244

Physics. Recent developments in the field of heat transfer are reviewed, particularly, conduction of heat in gases, radiative transfer, conduction in solids and liquids, forced and natural convection, heat flow with simultaneous phase change and using electrical and other type model methods.

Heat flow is treated as an example of a transport process in which one or more physical characteristics of a molecular assembly may be transferred from point to point by movement of certain "carriers." Significance, limitations and value of analogies between heat flow, fluid friction, chemical diffusion and electric current are discussed.

Servomechanism Analysis. *(1953 First edition). By G J Thaler, asst prof of electrical engineering, U S Naval Postgraduate School, and R G Brown, senior project engr, General Motors Corp. 6¼x9¼, 414 pp, many figs., tables, $7.50. McGraw-Hill Book Co, 330 West 42nd Street, New York 36, N. Y.*

Written for electrical engineering students in senior and graduate courses. The book reviews the basic principles and concepts of servomechanism operation as an introduction to the design and analysis of servomechanism systems. One chapter covers relay servomechanisms because of their growing importance.

Another chapter is devoted to the root-locus method which provides a convenient method of calculating transient response from the transfer-function equation. Also the concept of pole and zero configurations seems to offer promise for future developments in analysis and design of systems.

An interesting feature of the book are the 67 pp of appendices which cover practical equipment used in servo systems. These include: potentiometer bridges, E transformers, synchro generators, synchro motors, differential units, tachometer bridges, temperature and pressure detectors, pH detectors, controllers, servomotors, compensating devices.

Turbines, Condensers, and Auxiliaries, Feed-Water Heaters, Evaporators and Deaerators. *(1950). A report by the Turbines and Condensers Subcommittee of the Prime Movers Committee, 8½x11½, 71 pp, paper, 28 figs, 13 tables, $1.30 to members, $3.50 to non-members domestic. Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.*

A report containing statements by operating companies and manufacturers of equipment listed in the title. It also reports data on turbine operating experience and outages. Included are data on simultaneous unscheduled outages of major plant equipment.

Topics discussed in the report cover steam conditions for new units, preferred standards utilization, excitation practice, unit installations, quick starting of turbines, generator field preheating, hydrogen system operation, supervisory instruments, turning gears, troubles, governors, and testing and overhaul practices.

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JOHN CRANE CRANE PACKING COMPANY

More BOOKSHELF

Begins on page 244

Steam Power Stations. *(1952 Fourth Edition). By G A Gaffert, mechanical engineer, partner Sargent & Lundy. 6¼x9¼, 637 pp, 432 figs, tables, charts, $8. McGraw-Hill Book Co, 330 West 42nd Street, New York 36, N. Y.*

This well known book has been revised to incorporate the more recent developments in steam stations. The text covers major and auxiliary equipment operating principles together with arrangement in a station. Data are included on cyclone furnaces, pressurized furnaces, axial flow fans, extraction cycle techniques and reheat cycles.

As in earlier editions the book begins with fundamentals and develops for both the student and designing engineer the method of arriving at a completely integrated plant. The approach adopts the design and construction point of view. Only the mechanical end of the plant is discussed.

Statistical Tables and Problems. *(1952 Third edition). By A E Waugh, professor of economics, University of Connecticut. 6¼x9¼, 242 pp, tables, $3. McGraw-Hill Book Co, 330 West 42nd Street, New York 36, N. Y.*

This manual will serve the needs of student and professional statiticians. It includes 35 tables of functions needed by the statistician. The more common statistical formulas, 137 in number, are included for convenient reference.

The manual is designed to be used in conjunction with a text. It contains several hundred exercises and problems in elementary statistics.

Control of Electric Motors. *(1952, Third edition). By Paisley B Harwood, Vice-president, Cutler-Hammer, Inc. 538 pp, 6x9 in., illust, cloth, $7.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 6, N. Y.*

This edition, like the last, is arranged by motor types. Describing the design, construction and application of controllers for electric motors, it begins with a general discussion of wiring diagrams, construction details, and pilot devices as applied to all kinds of motor control. The book is then divided into two sections, one on dc, the other on ac motors and control. It covers operation, characteristics, and application of each motor, control methods, and the actual design of various types of control for that particular motor.

Data and diagrams have been brought up to date, and many new standards have been added to the text since the second edition. The previous material on electronics has been omitted, and a chapter on regulating devices and circuits has been added. There is also a series of 350 problems.

Electrical Code Diagrams. *(Vol II). By B Z Segall. 829 pp, 9x11 in., illust, cloth, $12.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

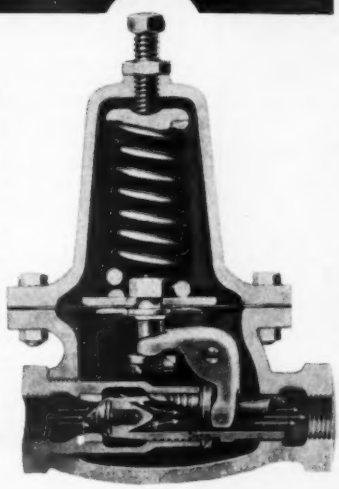
This is the second of a two-volume work that forms a most practical aid to understanding the *National Electrical Code*

THEY'LL SEE YOU THROUGH WITH *Non-Stop Production* . . .

● Smooth, speedy, non-stop production is a vital thing today. It's a great advantage to have the dependability of operation—the smooth, even flow of steam, air, or oil—the better pressure control and greater capacity obtainable with the "1000" Valve. The Streamlined flow pattern pictured shows the valve action so important in keeping things going on the production front. Years after they have been installed, "1000" Valves perform so that you continue to realize all of the ten benefits listed below. The "1000" is known as the "NO TROUBLE" Valve.

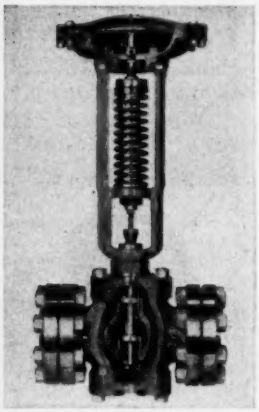
POINTS THAT COUNT BIG IN YOUR FAVOR

1. Maximum capacity when needed most
2. Accurate pressure control under toughest working conditions
3. Trouble-free service.
4. Smooth operation.
5. Tight closure.
6. Speedier production results.
7. Elimination of failures.
8. Cost-saving operation.
9. No spoilage.
10. Practically zero in maintenance.



HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown at left which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 34 Pressure Reducing Valve. For practically all fluids. Has roller bearing, also roller guides that kill side strains and stop packing trouble—no lost motion.

Sizes: ½" to 12" inclusive. Highest initial pressure 800 lbs.; reduced pressure vacuum to 150 lbs. Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type. Bulletin 968.

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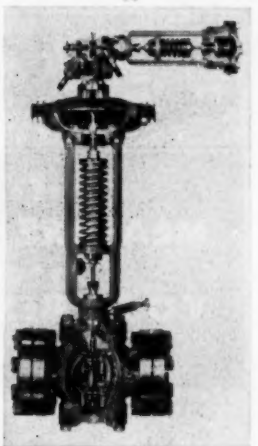

Cash Standard Type 30-AP Valve gives precise control of fluid pressures, through a pilot connected to the pressure under control. For steam, water, air, and most fluids.

Can be a pressure reducing valve or a back pressure valve depending on the way the control lines are connected. Pressures up to 600 lbs. Sizes ½" to 12" screwed; 1" to 12" flanged ends; wide variety of metals.

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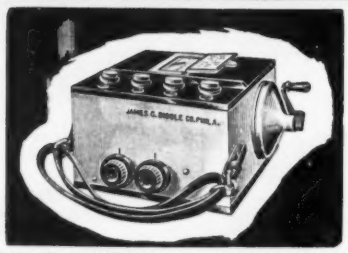

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Affords the facility of:

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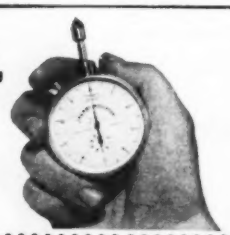

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More BOOKSHELF

Begins on page 244

(1951 edition) and doing work in accordance with it. It shows diagrammatically one or more illustrations for each Code rule, clarifying just how the rule may be applied. Illustrations must be used in conjunction with the Code, since these rules are not included as such in the book. (Copies of the *National Electrical Code* are available from National Board of Fire Underwriters, 85 John St, New York 38, N. Y.)

Besides the diagrams, supplementary text is given where helpful. This background material shows the why of the rules. Both practical and theoretical material is given. The second volume deals with equipment for general use, special occupancies, special equipment, special conditions and communication systems.

Alabama Power Co plans further expansion of its steam-electric generating plants at Gorgas with the construction of a new plant to be known as Gorgas No. 3. The new $25,000,000 plant will have an initial 150,000 kw General Electric turbo-generator and it is expected that the plant will be further expanded to three or four more units. The first unit will be completed in 1955. When the new plant is in operation the coal requirements at Gorgas will be increased to 1,500,000 tons annually.

Bids will be called immediately for construction of a $52 million three-dam project on California's Stanislaus River, following approval of a bond issue by South San Joaquin-Irrigation District voters. Residents voted to issue $26 million in revenue bonds as their share of the cost. Voters in the Oakdale Irrigation District had already approved a similar bond issue. Three dams and three powerhouses will be built on the river at Donnells, Beardsley and Tullock to provide storage space for 230,400 acre ft of water and produce 81,000 kw of power. Bonds will be paid by selling power to Pacific Gas & Electric Co.

AMSTERDAM—*McGraw-Hill World News*: Development of Philips' hot air engine has been nearly completed, according to Philips Incandescent Lamp Works. Small, practically noiseless, hot air engines are already being produced in series at the Dordrecht factory and are in demand by domestic industries. A full statement will be made next year.

Tacoma, Wash. has approved a new city charter which provides that City Light and other municipal utilities will be operated by a board virtually independent of the city council. The board will have "full power to construct, condemn and purchase, acquire, add to, maintain and operate the electric, water and belt line railway utility systems," although "all matters relating to system expansion, the incurring of indebtedness, and the fixing of rates and charges" shall be subject to approval by the council.

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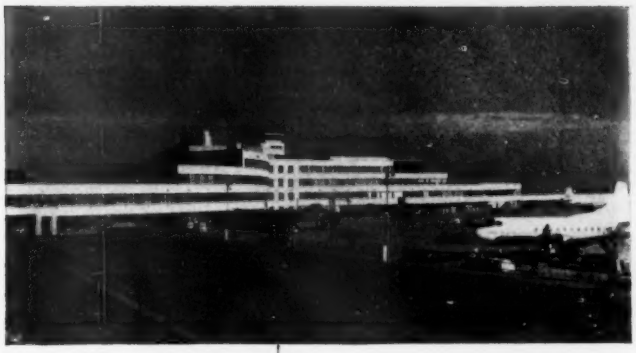
...including complete Air Conditioning

with JOHNSON AUTOMATIC TEMPERATURE CONTROL



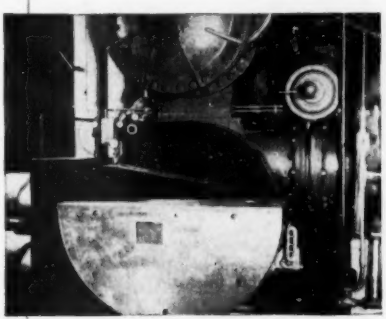
Terminal Building, Greater Pittsburgh Airport, Pittsburgh, Pa. Joseph Hoover, architect; Theodore F. Rockwell and Elwood F. Tower, mechanical engineers; McGinness, Smith, McGinness Company, heating and air conditioning contractors, all of Pittsburgh.

The Greater Pittsburgh Airport, 14 miles west of Pittsburgh's famed "Golden Triangle", provides practically every convenience that the public desires. Literally a small city in itself, this most complete commercial air terminal in the world offers the ultimate in service and comfort.

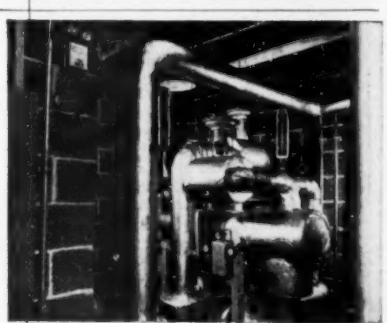
The gigantic, seven-story terminal building is air conditioned throughout and includes hotel facilities, offices, motion picture theater, dining room, coffee shop, cocktail lounge, night club, post office, exhibit rooms, retail shops and public areas.

These diverse services present many different temperature regulation problems, most of which are solved *automatically* by the proper application of Johnson Control. All the way from the control of individual room temperatures, for human comfort, to the protection of delicate electronic devices associated with the safe operation and guidance of aircraft, the Johnson "Planned-for-the-Purpose", "Installed-for-the-Purpose" Control System solves the problems effectively.

The same systems which are applied to the most intricate temperature regulation problems in the nation's outstanding buildings are also available to you. Whether your building presents a multiplicity of problems or a relatively simple application of automatic temperature control, call a Johnson engineer from a nearby branch. He has the benefit of the many years of experience which has been accumulated by the only nationwide organization devoted exclusively to manufacturing, planning and installing automatic temperature control systems. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branches in Principal Cities.

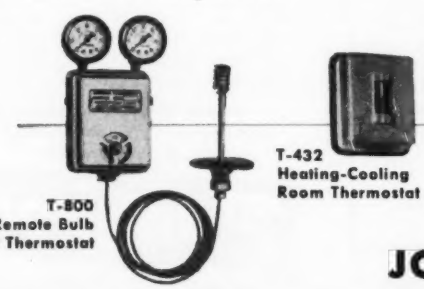


Johnson T-901 Remote Bulb Submaster Thermostats, readjusted by S-222 Gradual Switches, control the capacity of each of two 350-ton Carrier centrifugal refrigerating machines that furnish chilled water for the cooling system.



Behind the scenes, in machine rooms, Johnson T-800 Master Remote Bulb Thermostats, measuring the outdoor temperature, readjust T-901 Submaster Thermostats which control V-185 Valves on the steam supply to the converters.

Hotel guest rooms have units supplied, during the heating season, with hot water and, during the cooling season, with chilled water controlled by Johnson Submaster instruments. Many individual offices in the building have Johnson T-432 Heating-Cooling Room Thermostats in addition.

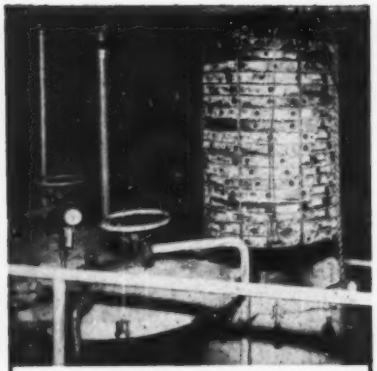


T-800 Remote Bulb Master Thermostat

T-432 Heating-Cooling Room Thermostat

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

MANUFACTURE • APPLICATION • INSTALLATION • SINCE 1885



Leaf assembly being removed from one of three vertical filters at B. F. Nelson.

How B. F. Nelson Mfg. Co.

increased condensate in boiler feed 70%

with SORBO-CEL®

When B. F. Nelson Mfg. Co. added new 425-psi boilers, oil in condensate was an expensive problem . . . until they switched to Sorbo-Cel filtration.

Average oil concentration in old boilers was 65 ppm. Concentration in condensate receivers ran 33.4 ppm, mostly emulsified. About 50% of boiler feed was condensate. Problem: to keep oil out of new boilers. *By comparing methods, they found that filtration with Sorbo-Cel . . . a specially processed diatomite filter aid . . . did the best job.*

Sorbo-Cel slurry is fed into condensate to attract oil and hold it until it reaches filters. Sorbo-Cel collects on plates and builds up a highly porous cake. Operation is continuous until there is no more room for cake between plates—usually 70 hours.

Today, 85% of boiler feed is condensate. Labor-and-material costs are only 1.7 cents every 1000 lbs. Since B. F. Nelson produces two million pounds of steam a day, savings from reclaiming such a high percentage of condensate can readily be imagined.

For further information about Sorbo-Cel filtration mail the coupon below.

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Please send me free bulletin giving advantages of Sorbo-Cel filtration.

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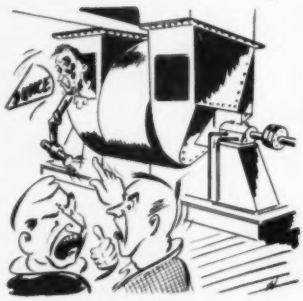


My Biggest Boner

► THIS STUNT gave me both a red and a black face—red from embarrassment, black from soot. I don't know which was worse but I learned a good lesson. Here's how.

My firm installed an induced-draft fan and a finned-tube cast-iron economizer for one of our clients. The job hadn't been on the line long before we had complaints of insufficient draft for full boiler load.

I was sent out to the plant and listened to the operating engineer as he described his troubles. As I was sure the fan specs and performance were right, I listened with a superior smile on my face. Then I went to work.

I checked outlet damper closed position and then opened damper wide until the lever hit the stop. Connecting an ammeter, draft gage and thermometer, I made a test run. It showed draft was low at fan inlet and pressure at stack base, on fan discharge side, was also low. So was ammeter reading. I figured trouble came from debris in duct or wrong duct design.

Next Sunday, with my boss and the fan manufacturer along, I climbed into the duct. It was clear but damper was half closed. When I climbed from the sooty duct and tested damper we found it swung from fully closed to fully open to half closed. This info was given in fan catalog but we overlooked it. I should have known from ammeter reading that fan was not taking full power.

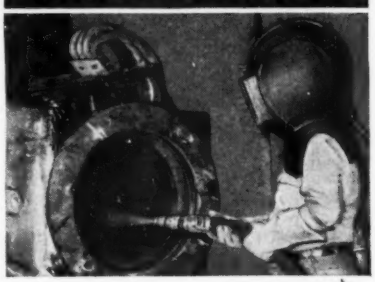
I was glad you couldn't see how red my face was, because black soot hid it. We now paint damper positions on fan before starting up a new job.

K LOWENSTAM
Buenos Aires, Argentina

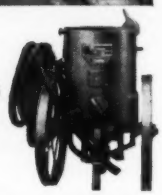
● What is your "biggest boner"? We'll pay ten dollars for each one we publish.

YES!

Pangborn's "Corn Grit" AC-4 Blast Machine CLEANS Diesel-Electric Motors WITHOUT SOLVENTS!



SAVES TIME BECAUSE DRYING PERIODS ARE UNNECESSARY!



The Pangborn AC-4 Blast Machine cuts down-time to less than half by *eliminating waiting* for parts to dry . . . by *cleaning faster* . . . by *requiring no dismantling* in most cases. It uses soft 20-mesh corn cob grits to remove dirt, grease, old paint, etc. quickly and efficiently, without harming coils and other delicate parts. Look at these features:

- **Cleans in less than half the time of other methods**
- **Requires no drying periods**
- **Material costs average 90% less than old-fashioned methods**
- **Does better job, leaves parts clean and bright**
- **Eliminates toxic hazards of solvents**
- **Portable—easily moved from job to job**

Write for complete information, telling us what you clean, to: PANGBORN CORPORATION, 90 Pangborn Boulevard, Hagerstown, Maryland.

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment.

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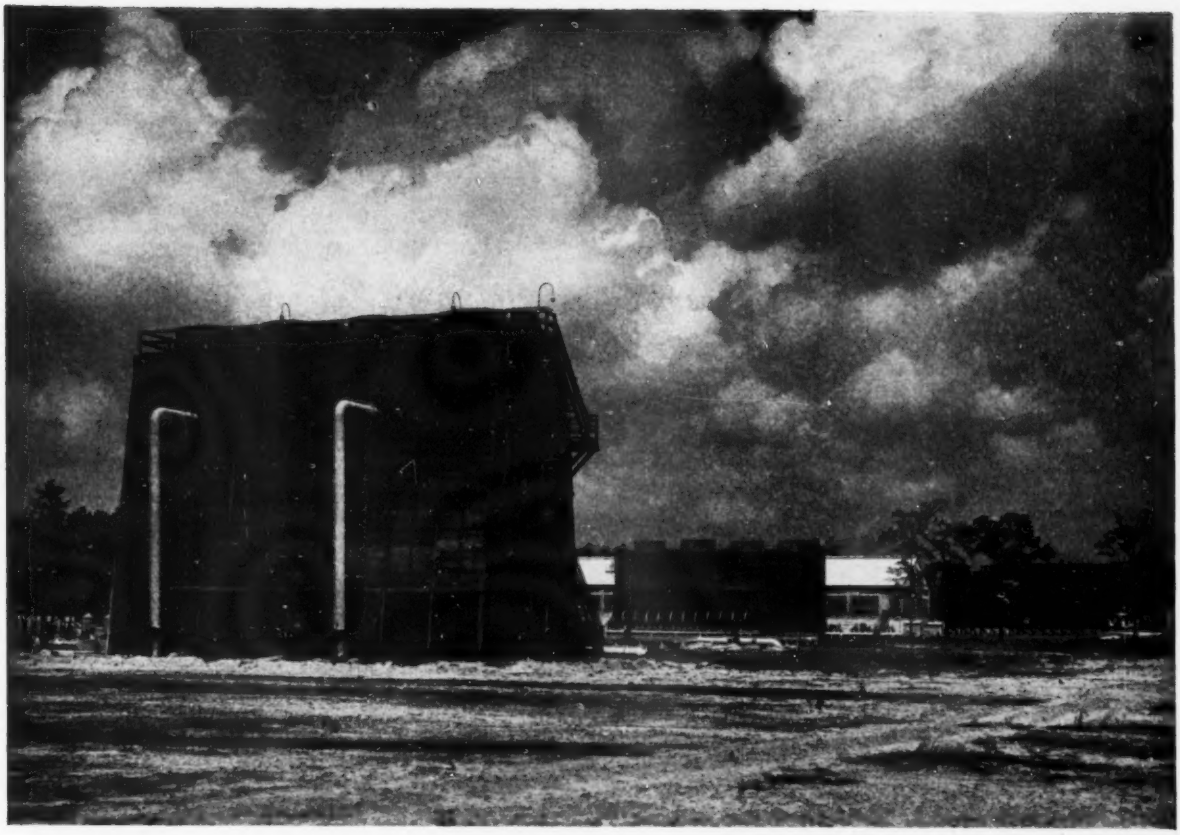
with the right equipment for every job



RE-ORDERS . . .

Bulletins on HUDSON TOP PERFORMANCE cooling equipment mailed upon request.

The three cooling towers pictured above are a part of EIGHTY large Hudson cooler installations made by a gas transmission company—installations involving HUDSON cooling towers, atmospheric sections and HUDSON Solo-aire units made in eight different states from Texas to New York.

The fine performance, low operating cost, mechanical excellence, and good business relations experienced by buyers of Hudson equipment, make Hudson the favored supplier when additional installations are considered. Over SEVENTY-FIVE PERCENT of Hudson cooling equipment now being manufactured will be installed for present users.

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ENGINEERING CORPORATION
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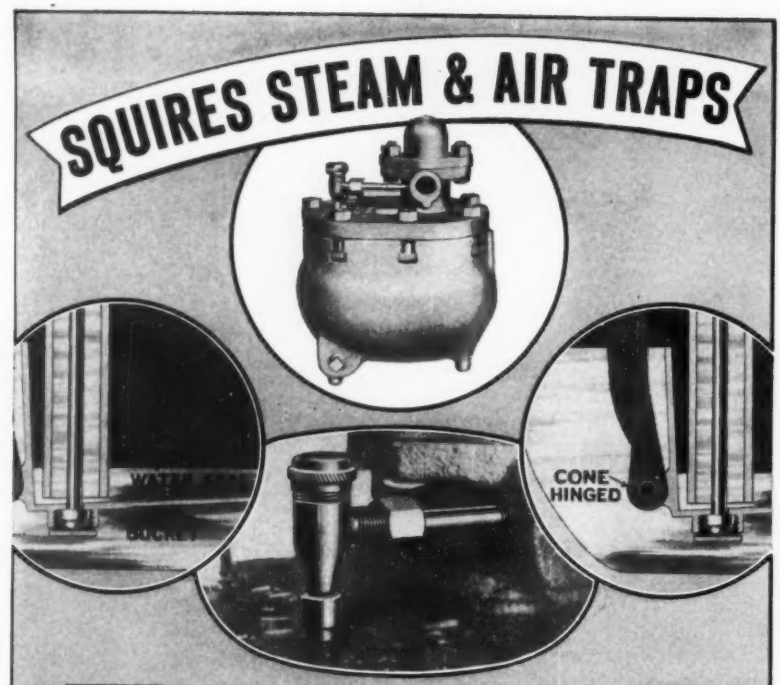

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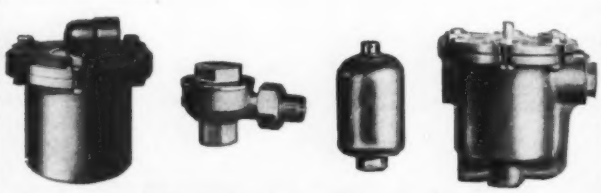
The Genuine SQUIRES upright bucket trap is the forerunner of all present day steam traps of similar design. Combining ruggedness with simplicity of design it insures long and uninterrupted service.

Equipped with *Automatic Air Release,* SQUIRES steam traps will rapidly expel air with condensate, without loss of steam, shortening time of warm-up period, giving faster heat and cutting down length of heating period necessary on many types of installations. Prevent air binding.

Only one internal part of the SQUIRES trap is subject to friction movement. The patented cone bucket hinge, accounting for the low maintenance required to keep SQUIRES in first class condition, demanded in these times by the most exacting operators.

Positive water seal in SQUIRES traps absolutely prevents steam loss as discharge tube is always completely full of water.



SQUIRES—MOUAT Heating Specialties, radiator traps, air vents, float traps, bucket traps etc. are the latest addition to the SQUIRES family of steam equipment. *Write for further details.*

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Over 50 Years of Dependability

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Begins on page 163

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MECHANICAL TRANSMISSION

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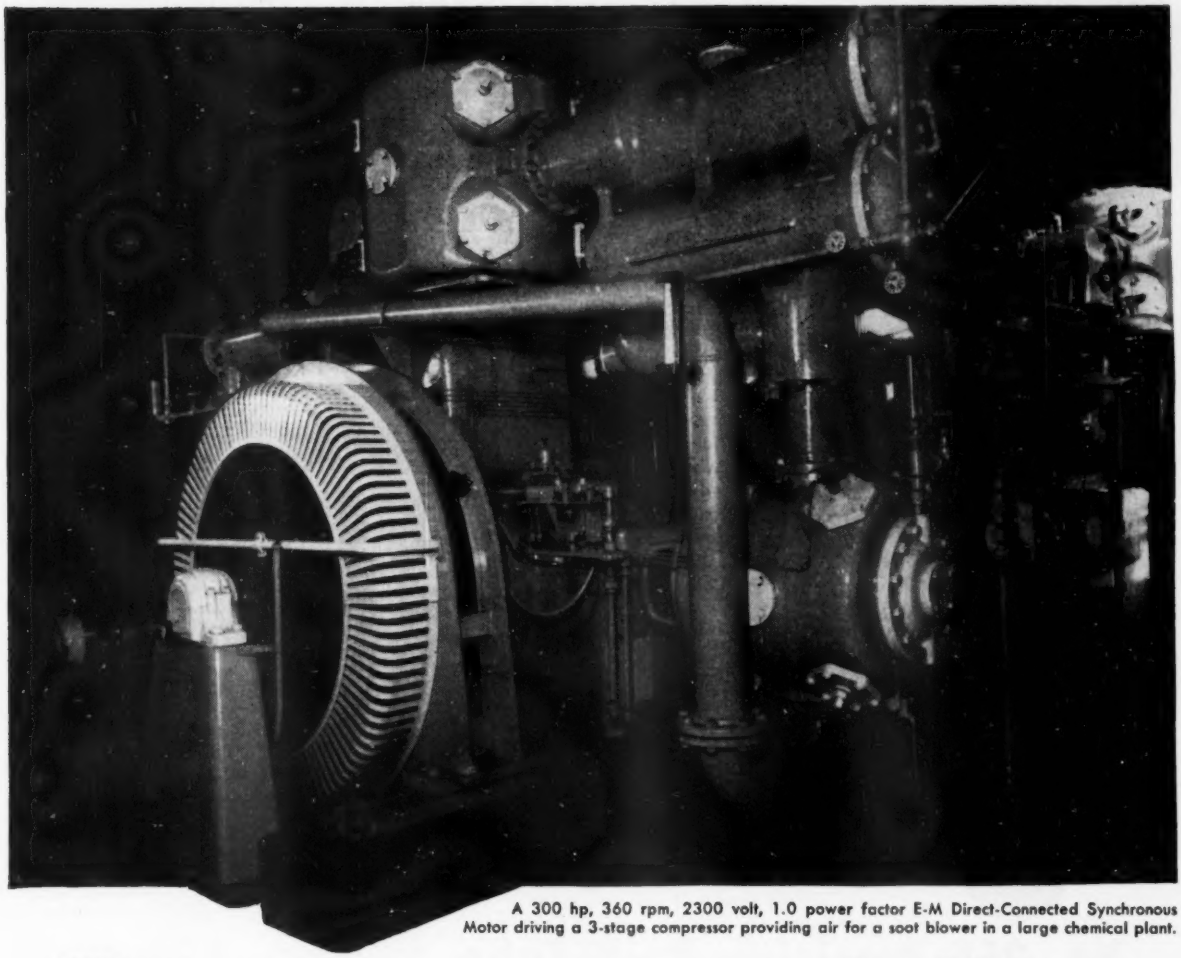

A 300 hp, 360 rpm, 2300 volt, 1.0 power factor E-M Direct-Connected Synchronous Motor driving a 3-stage compressor providing air for a soot blower in a large chemical plant.

What every new compressor should have

● Nicest thing you can do for a new large compressor is to couple an engine-type synchronous motor to it. There's no better way to assure a most economical, reliable and trouble-free drive.

Look at the big advantages you get with a direct-connected synchronous motor:

1. HIGH EFFICIENCY conversion of electric power to mechanical power by synchronous motors . . . resulting in minimum electric power cost operation of the compressor.

2. POWER FACTOR CORRECTION by unity or 0.8 leading power factor synchronous motors . . . supplying leading reactive kva to improve plant power factor and further reduce power costs, save money on your power bills.

3. DIRECT-CONNECTED synchronous motors save valuable floor space and require minimum maintenance.

4. SIMPLE STARTING at full voltage is suitable for most direct-connected synchronous motor compressor applications. Or you can use E-M-invented part-winding starting where starting limitations are severe. These starting arrangements have low first cost and low maintenance costs.

And there's nothing nicer for your compressor than an *E-M* Direct-Connected Synchronous Motor. E-M, pioneers in the development of synchronous motors and control, have over 40 years' experience in the design of synchronous motors incorporating desirable characteristics and features such as those above.

Let the E-M specialist engineer team design a smooth-running, modern drive unit to meet the requirements of your new compressor application. For complete information on E-M Synchronous Motors and their application in your plant, consult your nearest E-M sales engineer. And write for the issue of the E-M Synchronizer titled "The ABC of Synchronous Motors".

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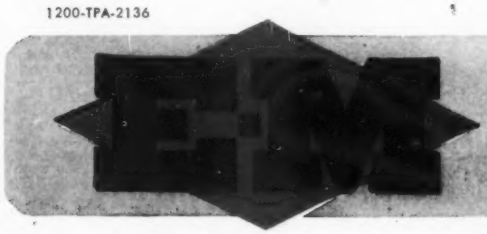
1200-TPA-2136



SPECIALISTS IN
BIG MOTOR ENGINEERING

MARTINDALE

PROTECTIVE MASKS

PLACE HEAD-BAND WELL UP AROUND HEAD TO KEEP FROM SLIPPING DOWN
PRESS NOSE TABS IN CLOSE AGAINST FACE TO HOLD PAD AGAINST THE NOSTRILS
PRESS EDGES OF FACE PLATE DOWN TO FIT FACE SNUGLY

Weigh Less than ½ ounce.

Clean, cool, comfortable. Excellent protection against non-toxic dusts except free silica. Replaceable cotton pads are inexpensive and sanitary.

Martindale Protective Masks.....$.30 ea.
No. 1 Refills (Standard weight)..... .02 ea.
No. 2 Refills (heavyweight)..... .02½ ea.

Masks packed individually. Refills packed 25 to envelope. No. 2 (heavyweight) Refills contain twice as much filtering cotton as No. 1.

DISCOUNTS

Less than $10.00 list.....Net
$10.00 to $24.99 list.....10%
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$100.00 and over.....20%
Minimum, charge account or C.O.D.....$2.00
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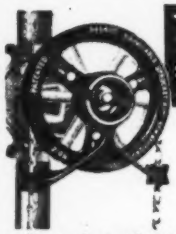
If payment accompanies order we will pay parcel post or express charges.

MARTINDALE ELECTRIC CO.
1385 Hird Ave. Cleveland 7, Ohio

FOR SAFETY'S SAKE
Control Valves from the Floor



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Adjustable
SPROCKET RIM
with Chain Guide

ELIMINATES STEP-LADDER CLIMBING RISKS

● Range of 10 adjustable sizes take care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Climbing on benches, machines, boilers or treacherous stepladders to control overhead valves is absolutely unnecessary, foolish risking of life and limb. Why permit such risks when the safe and sure BABBITT Adjustable Sprocket Rim with Chain Guide is available at such low cost? Overhead valves are conveniently and safely operated right from the floor!

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

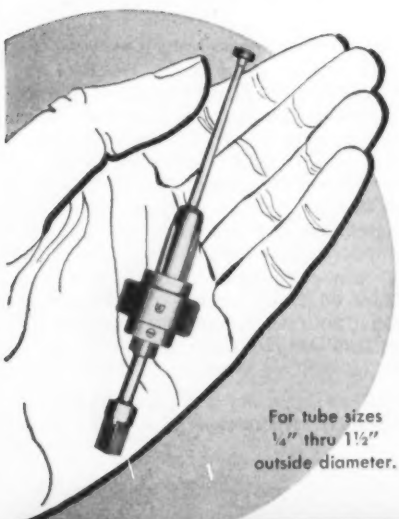
● *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor*

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

IDEAL

They Said it couldn't be made— but here it is!

No. 255 Precision-Built Tube Expanders



For tube sizes ¼" thru 1½" outside diameter.

These precision Ideal Tube Expanders are unequaled for rolling tubes in Condensers, Coolers and other heat-transfer units. The Ball Bearing, adjustable thrust collar reduces friction to a minimum. You get every desirable feature—plus—in No. 255.

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THE GUSTAV **WIEDEKE** COMPANY
DAYTON 1, OHIO

More FREE BULLETINS

Begins on page 163

12 pages. Wall-Colmonoy Corp, 19345 John R St, Detroit 3, Mich.

METERS AND INSTRUMENTS

31 **FLOW TEST KIT**—for laboratory research and field flow checking work, carrying case. Catalog 33, 2 pages. Fischer & Porter Co, Hatboro, Pa.

32 **INSTRUMENTS**—for measurement and control in paper and pulp industries described in 24-page Bulletin A-130-1. Fischer & Porter Co, 7240 County Line Rd, Hatboro, Pa.

33 **HOOK-ON INSTRUMENTS** — for testing and general maintenance; volt-ammeter, wattmeter, power-factor meter. GEC-901, 8 pages. General Electric Co, Schenectady 5, N. Y.

34 **INDICATING PYROMETERS** — portable, bench, panel mountings; black and white face; —200 to 3000 F. Bulletin G-3, 4 pages. Assembly Products, Inc, Chagrin Falls, Ohio.

35 **EXPLOSIVE GAS DETECTOR** — indicators and alarms, portable and fixed. Operating principles and specs. Form FSE1251, 4 pages. Johnson-Williams, Ltd, 2708 Third St, Palo Alto, Calif.

36 **VIBRATION METER** — velocity and displacement measurement, either linear or torsional. Bulletin CEC-1505B, 4 pages. Consolidated Engrg Corp, 30 N Sierra Madre Villa, Pasadena 8, Calif.

37 **CARBON MONOXIDE DETECTOR** —measures and records concentrations of 0 to 5 parts per ten thousand. Bulletin 201, 12 pages. Taller & Cooper, Inc, 75 Front St, Brooklyn 1, N. Y.

PIPING, VALVES FITTING AND SPECIALTIES

38 **VALVES**—gate, angle, globe, check valves in bronze, iron, cast and forged steel with rating and trim charts, pressure-temperature charts. Catalog Digest, 20 pages. Ohio Injector Co, Wadsworth, Ohio.

39 **HOSE**—air and water suction hose for all service, specs, descriptions and recommended uses. Catalogs 2460 and 4600, 4 pages each. B F Goodrich Chemical Co, Rose Bldg, Cleveland, Ohio.

40 **STEAM TRAPS** — piston-operated compound traps, gives operation, physical data, capacities, installations. Bulletin No. 215, 8 pages. Armstrong Machine Works, Three Rivers, Mich.

41 **AUTOMATIC REGULATING VALVES**—for steam, internal or external, spring, weight and lever controlled. Bulletin 535, 12 pages. Kaye & MacDonald, Inc, 11-15 Central Ave, West Orange, N. J.

42 **GATE VALVES** — cast steel, 2½ through 12 in., 300-1500 psi, flanged or welded ends. Catalog No. 12-E. 6 pages. Edwards Valves, Inc, East Chicago, Ind.

PRIME MOVERS AND ACCESSORIES

43 **"KNOW YOUR CARBURATOR"** — 46-page booklet on basic theory, parts, troubles and remedies of the carburator. Pennsylvania Refining Co, 2686 Lisbon Rd, Cleveland 4, Ohio.

44 **FOUR-CYCLE ENGINES**—9 and 13 in. bore, diesel, dual fuel or spark-fired gas engines. Bulletin 205, 12 pages. Nordberg Mfg Co, Milwaukee 1, Wis.

45 **ATTACHMENTS** — for Caterpillar diesel engines. Cooling, exhaust, starting, safety, control, fuel systems. 32 pages. Caterpiller, Peoria, Ill.

46 **DIESELS** — 12 two-page spec sheets on Type 4FS one, two and three cylinder diesels, 4½ in. bore, 5¼ in. stroke, 10 to 45 hp, 1200 to 1800 rpm. Bulletins 208 through 219. Nordberg Mfg Co, Milwaukee 1, Wis.

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VALVES, FITTINGS and FLANGES

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This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

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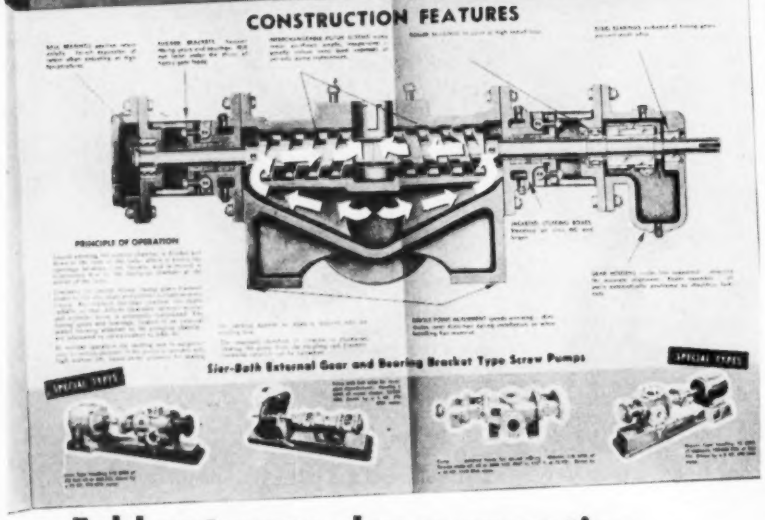
NEW BULLETIN (SE-5)

illustrating, describing



Fold-out page shows operation... construction details... special types

- **pump fuel oils, crude oils, cellulosics, distillates, etc.**
- **fluids and semi-fluids, 32 SSU to 1,000,000 SSU**
- **capacities 1-700 GPM**
- **discharge 1000 PSI for viscous liquids, 500 PSI for water**

Sier-Bath "Gearex" and "Hydrex" Gear Pumps for lower pressures and capacities

Recently introduced, this Sier-Bath Pump incorporates all the latest refinements of screw pump design . . . and then some. *Center line support* speeds assembly . . . *single point alignment* eliminates rotor distortion . . . *radial and axial* control of rotors by heavy-duty bearings for sustained efficiency, long life. For the *whole* story . . .

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Also Manufacturers of Precision Gears and Flexible Gear Couplings

More FREE BULLETINS

Begins on page 163

PUMPS

47 **SMALL VERTICAL PUMPS**—sidewall or submerged mountings, capacities to 250 gpm, heads to 125 ft. Bulletin 52B6975A, 8 pages. Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

48 **CENTRIFUGAL PUMPS**—portable, self priming, 2 to 4 in., 7,000 to 40,000 gph. Powered by 4-cycle, air-cooled gasoline engine. Bulletin 52, 4 pages. Rice Pump and Machine Co, Grafton, Wis.

49 **RUBBER - LINED CHEMICAL PUMPS**—½ to 8 in., cap to 2000 gpm, heads to 125 ft, speeds to 3500 rpm in smaller sizes, 1750 rpm for larger. Bulletin WQ-212, 4 pages. Warren Steam Pump Co, Inc, Warren, Mass.

50 **VERTICAL PUMPS**—for volatile fluids, gasoline, diesel fuel, crude oil, l-p gases, ammonia, etc. Bulletin 1026-10/52-5M, 6 pages. Johnston Pump Co, 3272 E Foothill Blvd, Pasadena 8, Calif.

51 **CLOSE-COUPLED PUMPS** — for general purpose use, capacities to 2500 gpm, heads to 550 ft. Bulletin 52B6083-A, 6 pages. Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

52 **SERVICE MANUAL** — covers installation, operation and maintenance of Warren reciprocating pumps. Bulletin 202, 20 pages. Warren Steam Pump Co, Warren, Mass.

53 **LIGHTWEIGHT PUMP** — 1½ in. self-priming, portable centrifugal pump, weight 55 lb, cap 6000 gph. Bulletins 151 and 152. Carver Pump Co, Muscatine, Iowa.

54 **HEAVY-DUTY ROTARY PUMPS**—herringbone-gear type, to 5,000 gpm and 100 psi; sliding-vane type, to 1,000 gpm and 200 psi. Data includes viscosity conversion table. Bulletin W-483-B2, 16 pages. Reciprocating Pump Div, Worthington Corp, Harrison, N. J.

WELDING

55 **ELECTRODE COMPARATOR** — pocket-sized, 9-in. slide rule gives electrode comparison in seconds. GEN-37B. General Electric Co, Schenectady 5, N. Y.

56 **WELDERS**—multi-range, stationary or portable, for all purposes. Bulletin J-4813. Hobart Brothers Co, Box DM-920, Troy, Ohio.

57 **WELDING EQUIPMENT**—welding and cutting outfits, acetylene generators, tools and accessories. Catalog 150, 36 pages. Modern Engrg Co, Inc, 3401-15 W Pine Blvd, St. Louis 3, Mo.

MISCELLANEOUS BULLETINS

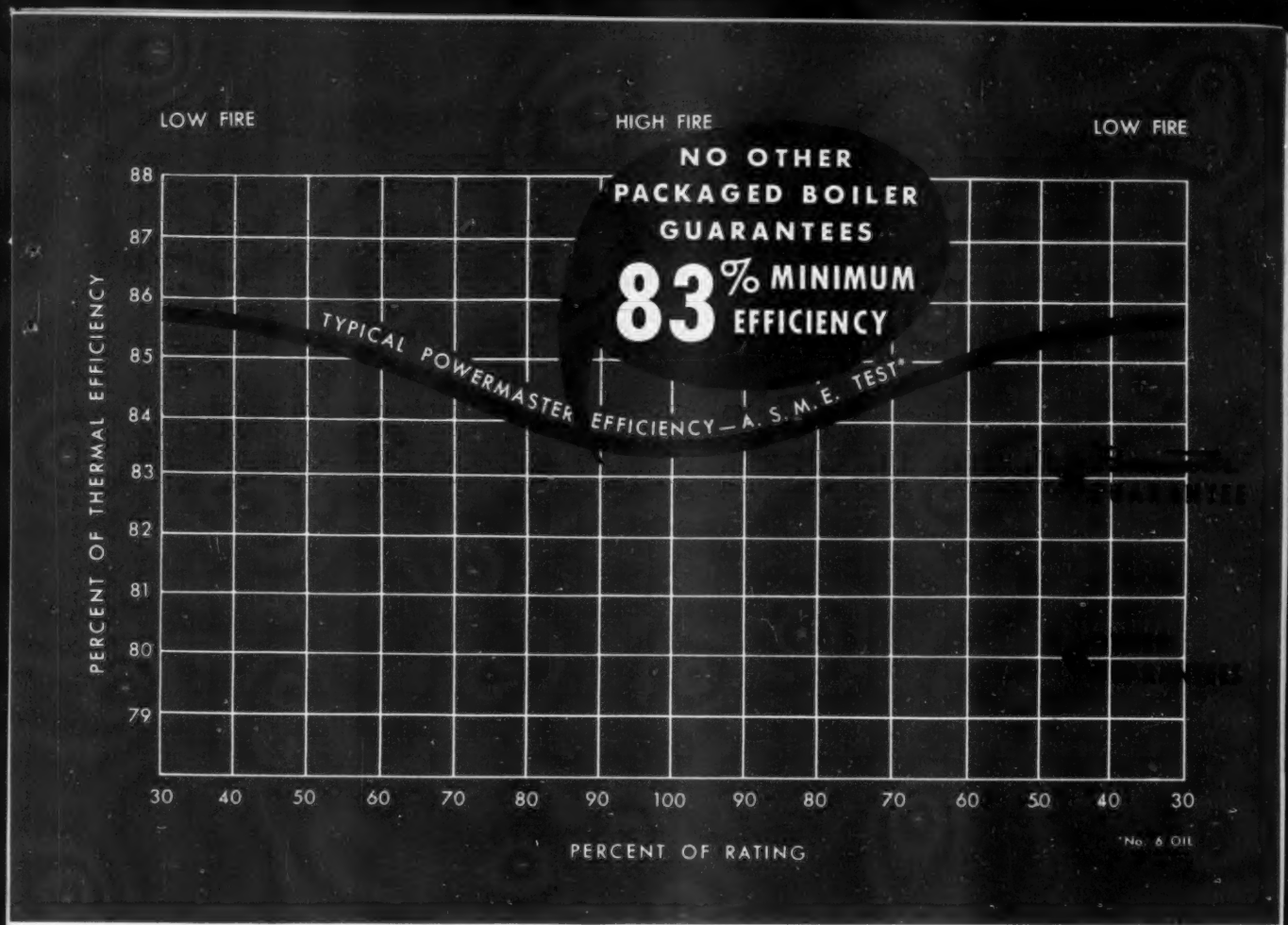
58 **I WANT TO KNOW**—About the Electric Industry; the answers to 27 questions frequently asked the Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

59 **THERE IS PLENTY OF TIN** — a booklet in defense of the Malayan tin producers. 20 pages. Malayan Tin Bureau, 1028 Connecticut Ave, Washington 6, D. C.

60 **ELECTRIC POWER**—Distribution and Equipment in Water Plants, an article reprint. Discusses planning and equipment. General Electric Co, Schenectady 5, N. Y.

61 **TURN ON THE LIGHT** — defines the electric power industry's position on the generation and distribution of power produced by the federal government. 16 pages. National Association of Electric Companies, Suite 510, 1200 18th St N.W., Washington 6, D. C.

To get copies of these bulletins, use post cards p 163. Identify your request with item number.



Only Powermaster guarantees 83%!

The "pay-off" on a boiler is its operating efficiency!

Take a look at this typical efficiency curve of POWERMASTER . . . then compare A.S.M.E. tests with those of any other boiler! At less than full load (which is normal in field operation) notice that POWERMASTER efficiency actually *increases.*

There's a reason for such efficiency. The POWERMASTER is the development of 68 years' experience in boiler manufacture. Continuing research and progressive engineering have consistently been reflected in POWERMASTER design:

- **FIRST to provide the Voriflow air-atomizing burner.**
- **FIRST to provide full modulating cam control.**
- **FIRST to provide immediate change-over from oil to gas firing.**
- **FIRST to provide a *complete* packaged unit.**

Point-by-point, POWERMASTER welcomes comparison. Before deciding on a new boiler for your plant, be sure to get the facts on the new POWERMASTER with VORIFLOW combustion. Just drop us a line and we'll be glad to send you complete information.

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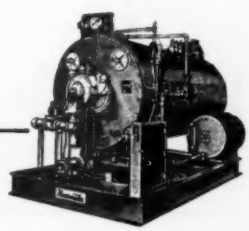
PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



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Pipe & Tubing

from stock

Large and varied stocks of stainless pipe and tubing are available for immediate shipment from Murray warehouse stocks. Sizes range from .125- to 8⅝-inch O.D. Sizes up to 24 inches O.D. can be supplied on special order.

If you have a pipe or tubing problem the experience of our specialists and the research facilities of our suppliers are at your service.

Other Murray products include carbon steel tubing and pipe for pressure and mechanical purposes; welding and screw type pipe and tube fittings. Tube bending, upsetting, swaging.

WRITE FOR CURRENT TUBE STOCK BULLETIN

7237

A B MURRAY CO INC
ESTABLISHED 1845
ELIZABETH, N. J. McKEESPORT, PA.

APPOINTMENTS

Corporation Executives

The **General Electric Co** announced that general managers of eight operating divisions of the company have been elected vice-presidents by the board of directors. Those elected were: James M Crawford, general manager of the Motor and Generator Division, Schenectady, N. Y.; Francis E Fairman, general manager of the Transformer and Allied Products Division, Pittsfield, Mass.; Cramer W LaPierre, general manager of the Aircraft Gas Turbine Division, Evendale, Ohio; Clarence H Linder, general manager of the Major Appliance Division, Louisville, Ky.; Harold A MacKinnon, general manager of the Component Products Division, Fort Wayne, Ind.; Charles K Rieger, general manager of the Small Appliance Division, Bridgeport, Conn.; Glenn B Warren, general manager of the Turbine Division, Schenectady; and William C Wichman, general manager of the Industrial Power Components Division, Plainville, Conn.

Warde B Stringham has been elected a commercial vice-president of the General Electric Co to succeed Edwin E Potter, Washington vice-president of the company, who is retiring after 43 years of service. Glenn E Seidel has been elected a vice-president of **Minneapolis-Honeywell Regulator Co** in charge of engineering in the company's Minneapolis plants.

Stone & Webster Engrg Corp announces that Frank A Stevens has resigned as treasurer but will remain as vice-president in the New York office; Alfred L Hartridge is elected treasurer. John C Nolan becomes assistant treasurer, and Fred R Stevens replaces Hartridge as personnel manager. Lyle B Schueler has been elected vice-president in charge of sales of the **Diamond Power Specialty Corp.** Lancaster, Ohio.

Hunter Michaels was appointed vice-president-operations for the **American Locomotive Co.** D W Cameron was named vice-president-manufacturing and Manuel Alonso is made vice-president-foreign sales.

David A Lewis has been elected vice-president of the **New York State Electric & Gas Corp,** in charge of general operations. Floyd I Fairman, director of customer service and advertising, and William H Skinner, director of rates and contracts, were elected vice-presidents of **Kentucky Utilities Co,** and A A Tuttle, secretary and treasurer, was elected to the board of directors to fill the vacancy recently caused by the death of Washington Reed, vice-president. Joseph E Cushman, **Utah Power & Light Co** division manager at Preston, Ida., has been named assistant to R H Ashworth, company vice-president.

Operations Executives

Andrew M Kennedy, Jr, E S Goodwin and J S Jacox have been appointed assistant general managers of purchasing for **Westinghouse Electric Corp,** and Richard E Ballentine has been appointed plant manager of the new welding-electrode plant being constructed at Montevallo, Ala.

You Can Expect These Advantages With —

TENNESSEE CORPORATION
Ferri-Floc
FERRIC SULPHATE

Ferri-floc a superior coagulant offers many advantages—Here's what you can expect with Ferri-Floc.—

1. Rapid Floc Formation?
2. PH correction?
3. Taste and odor control?
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6. Ease of operation?
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SULPHUR-DIOXIDE
HIGHEST QUALITY
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Sulphur Dioxide is effectively used in water treatment to remove objectionable odors remaining after purification.

COPPER SULPHATE will control about 90% of the micro-organisms normally encountered in water treatment plants more economically than any other chemical. Very effective for taste and odor control.

FREE—Let us send you free literature on the above products. Send card or letter to Tennessee Corporation, Grant Building, Atlanta, Georgia.

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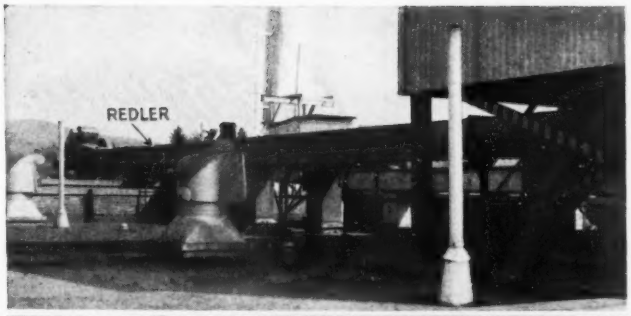

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Coal from track hopper is elevated by an S-A Pan Feeder to a double rotor Knittel Crusher. An S-A Belt Conveyor then takes it to the transfer house. Here it is discharged to another belt conveyor or to yard storage for later reclaiming by pan feeder from storage hopper. The second conveyor carries the coal to the roof of the boiler house and discharges it to a horizontal REDLER Conveyor that discharges through seven openings. An S-A Tellevel control at the head end of the REDLER prevents jamming. The System can handle 75 tons per hour.

S-A CONVEYING *Systems* handle coal in flexible flow

...HIGH volume at LOW cost per ton

Belt Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
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Skip Hoists
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Track Hoppers & Bin Gates
TELLEVEL Bin Level Controls
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Cigarette paper, an extensive line of thin paper specialties, and Olin cellophane are manufactured in large volume at this plant. Expanding operations requiring new power facilities made this new coal handling system necessary. You see here S-A equipment that takes coal from the track hopper, crushes it, and delivers as needed to boiler house bunkers or yard storage. It also reclaims from storage—and does the whole job with a minimum of labor or supervision.

S-A engineers have earned a reputation for their efficient, economical solutions to *all kinds* of coal handling problems. Drawing upon a vast experience, plus the most complete line of bulk handling equipment, they can help *you* to find a profitable answer to your bulk handling problems. Write and we'll arrange a meeting.

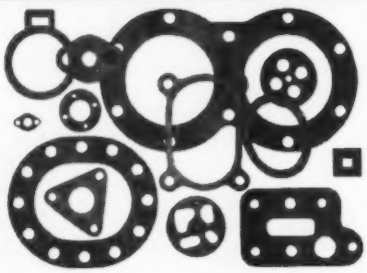
STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

Gaskets by BELMONT

Made Right to Seal Tight . . . LONGER



There's a Belmont Gasket — molded, formed, extruded, or die or lathe cut—for every gasketing service. They're made for *better* joint and surface seals . . . under any combination of service conditions . . . from a wide range of materials including Compressed Asbestos, Woven Asbestos Metallic, Red Rubber, Cloth Inserts, Black Rubber, Vegetable Fibre, Cork-Vegetable, Gray Rubber, Neoprene, Buna-N, Teflon, Silicone and many other compounded materials.

Because Belmont Gaskets are accurately and uniformly cut from just the right material to suit your particular service, they can usually be expected to deliver a valuable saving in maintenance costs and uninterrupted service by providing longer, more dependable service life.

Write or call your Belmont Distributor for recommendations . . . and get reference Catalog No. 40. 4-M-4A

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Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
There's a Belmont Packing for every service

More APPOINTMENTS

Begins on page 260

Arnold I Thorsen, works manager, **Allis-Chalmers Mfg Co,** Norwood Works, has been appointed assistant director of manufacturing of the company's general machinery division. R Randall Irwin has been appointed manager of personnel and industrial relations for the Brown Instruments Division of **Minneapolis-Honeywell Regulator Co.**

Robert C Thumser, plant engineer of **Monsanto Chemical Co's** John F Queeny plant since 1947, has been named to the new position of co-ordinator of standards of the General Engineering Department. The appointments of Don L Hinmon, as assistant to the general manager of the Industrial Products Division; and A J Bette as product manager for friction materials; E H Wells, as assistant to the merchandise manager; and G R R Wahl, as assistant product manager for Transite pipe, have been announced by the **Johns-Manville Corp.**

Engineers

The appointment of Harold D Newell as consulting metallurgist and John J B Rutherford as chief metallurgist of the Tubular Products Division of **The Babcock & Wilcox Co** has been announced. William B Cott has been named manager of air conditioning application engineering for the Sturtevant Division, **Westinghouse Electric Corp,** Hyde Park, Mass.

W E Chandler, who has been plant engineer at the Nitro, W Va plant of **Monsanto Chemical Co** since 1951, will become plant engineer at the John F Queeny plant in St. Louis. He will succeed Robert C Thumser, who has been transferred to the General Engineering Department. Thomas M Morrow, area engineer at the John F Queeny plant, will take Chandler's place at the Nitro plant.

Dr W T von der Nuell, formerly senior project engineer for aircraft turbo-machinery at **AiResearch Mfg Co,** was appointed senior project engineer in charge of special projects. He will supervise engineering and industrial development of new AiResearch products for commercial markets. Helmut Schelp, who recently completed establishment of a special projects engineering group, was named to investigate and screen new products for manufacture. His duties will also include market research and new applications for AiResearch products.

Sales Managers, Personnel

Jerry G Rizzo has been appointed manager of the Export Department, and Samuel K Hostetter, Jr, has been named sales manager of the Crocker-Wheeler Division of **Elliott Co.** Newly named sales representatives to **Allis-Chalmers** general machinery division district offices are John H Gerber, James R Donaldson and William S Wright, while Henry F Banzhaf has been named to the newly created post of manager of sales of Allis-Chalmers control operation, Hawley Works.

The **C O Bartlett & Snow Co,** Cleveland, has appointed John R Hersey, assist-

Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes 1/8" to 3"; 6000-lb. sizes 1/8" to 2".

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

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With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

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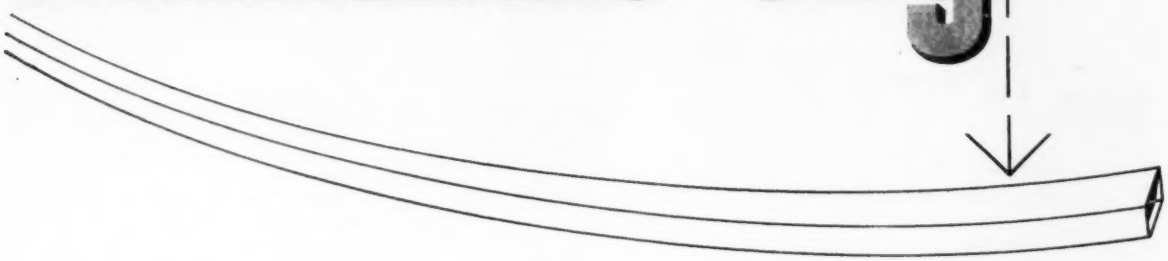
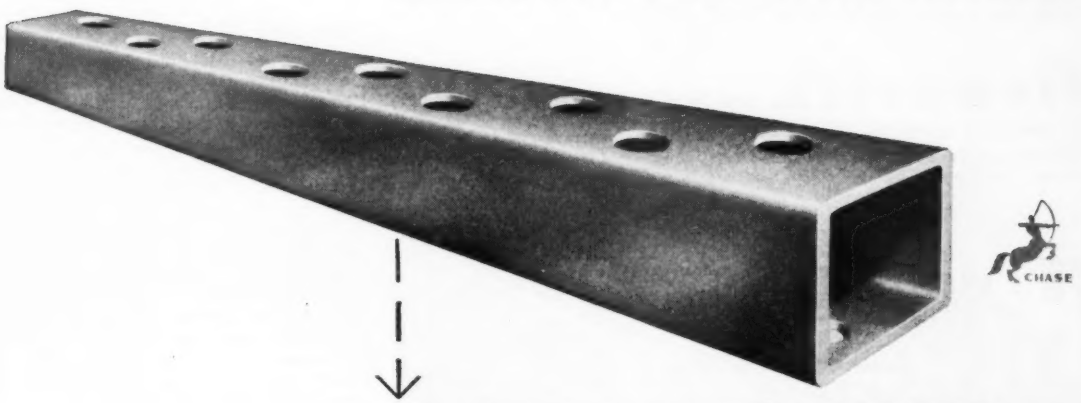
Minimize Sag



with CHASE® COPPER BUS CONDUCTORS



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And, of course, Chase one-piece buses have the mechanical strength necessary to stand up under heavy short circuits.

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FREE Chase Copper Bus Conductor booklet gives physical and electrical characteristics and data on copper saving.

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Waterbury 20, Connecticut

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Chicago	Houston†	Newark	Rochester†	(† sales
Cincinnati	Indianapolis	New Orleans	St. Louis	office only)

When you tread on Hendrick Mitco Open Steel Flooring it's much like walking on air. Because Hendrick flooring actually affords 90% open area for light and air, yet provides a level walking surface both strong and safe.

how to walk on air...

Hendrick Mitco is pressure-formed — there are no vulnerable bolts, rivets or angle irons to cause weak spots — no welds that might warp. Rectangular square edge steel bars assure extra ruggedness to support heavy loads without any resultant lateral deflection. For more complete information write Hendrick today!

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Sales Offices in Principal Cities • Perforated Metal • Perforated Metal Screens • Wedge-Slot Screens • Architectural Grilles • Mitco Open Steel Flooring • Shur-Site Treads • Armorgrids

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All standard sizes and extra gauges

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McKEES ROCKS, PA.

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PITTSBURGH • CHICAGO • FRED S. RENAULD & CO., LOS ANGELES

More APPOINTMENTS

Begins on page 260

ant sales manager. **Rockwell Mfg Co** has announced the appointment of J H Walters as Houston district sales manager. Walters will be responsible for the coordination of all Meter and Valve Division sales in the Houston district, which covers sections of Texas and Louisiana. Francis L Schmale, formerly assistant sales manager, has been promoted to general sales manager of the **Double Seal Ring Co,** of Fort Worth, Tex.

Columbia Electric Mfg Co, Cleveland, Ohio, announced the appointment of Homer W Sussman as general sales manager. W J Goerisch has been appointed central district sales manager at Chicago for the **Graybar Electric Co.** He has been general power apparatus sales manager in the company's general department in New York City. **Link-Belt Co** announces the appointment of Hubert J McCormick as sales manager of the Caldwell plant, Chicago. Samuel Garre, Jr, has been appointed director of sales for **Ehret Magnesia Mfg Co,** Valley Forge, Pa.

New Sales Offices

Westinghouse Electric Corp has announced the creation of a St. Louis branch office which will function in addition to the present Southwestern District headquarters office. E S Rehagen was named branch manager, and he has appointed four sales supervisors to the branch office staff. They are Fred N Wightman, Burl J Snow, Edward B Scruggs, and Ben H Marshall.

Cyclotherm Corp has announced the opening of a Chicago office located at Rms 729-730, Manhattan Bldg, 431 S Dearborn St, Chicago. Serving as head of the new office and chief consultant is Joe David. The opening of a new Export Office in New York City is announced by **D W Onan & Sons Inc,** Minneapolis, manufacturers of electric generating equipment. It is located in Room 1501, 141 Broadway, New York 6, and A S Callan is named as manager.

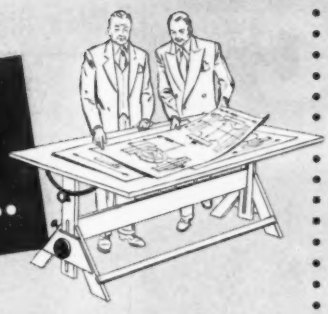
Eaton Mfg Co's subsidiary, Dynamatic Corp, Kenosha, Wis. manufacturers of variable speed drives, announces the opening of a Philadelphia Office at 4525 North Broad Street. Eugene Pohl has been appointed district manager.

New Distributors, Representatives

The Hilliard Corp, Elmira, New York, announces the appointment of Philips Export Corp, 100 East 42nd St, New York 17, N. Y. as world-wide export representatives for their Hilco line of lubricating, fuel and industrial oil filters and maintenance equipment, and the appointment of Jules D Gratiot Co, 1101 Riverside Drive, Los Angeles, as their representatives in California.

Robert P Saunders and Chas L Saunders have formed their own sales agency in Atlanta, Georgia. Address of the new company, **Control Equipment Co,** is 1222 Peachtree Street, N.E., Atlanta, Georgia. It will provide southern process industries with complete sales and service facilities for modern control equipment.

HOW SPENCE DESIGN...

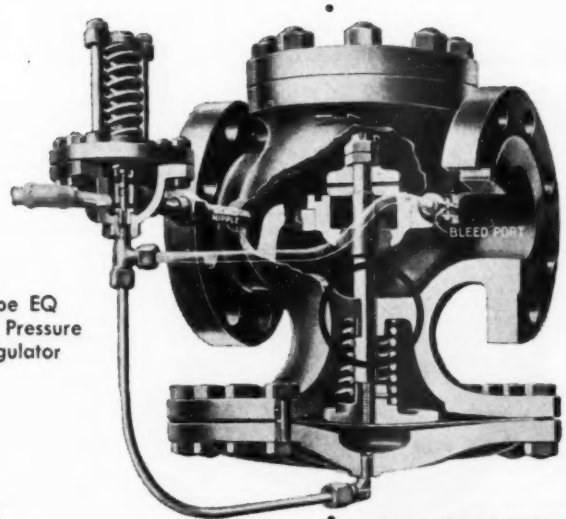


eliminates stuffing boxes

All Spence main valves and most pilots are built without stuffing boxes. This packless construction is made possible by the use of a large balanced metal diaphragm which eliminates the need for closely fitted parts. Result? More accurate regulation.

Valve stem wear is also reduced in the Spence packless design. Result? Low maintenance, years of trouble-free service.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governors and many other types. Write for bulletin 100 giving full details.



Type EQ
Back Pressure
Regulator

A few other design features:

SECO METAL SEATS AND DISCS— Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PROTECTED SPRINGS— The internal springs in the Spence Main Valve and Pilot are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

METAL DIAPHRAGMS — Located in a cooled zone with a condensate seal above and below, never have to be replaced under normal conditions.

Spence

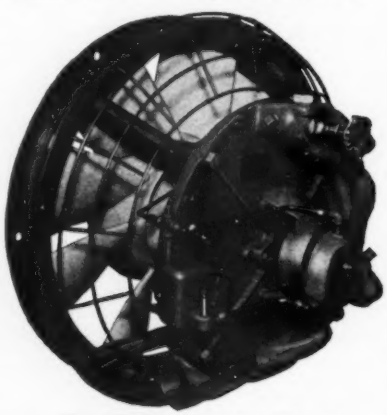
SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

A COMPACT Turbine Blower Installation

Here is an example of the adaptability of the Wing Turbine Blower to the limitations of restricted space. Additional boiler installations at the E. R. Squibb & Sons, New Brunswick, N. J., plant left little space for auxiliary equipment. As the photograph shows, the complete Wing turbine and blower (47,000 CFM, at 5" s.p., at 1850 RPM) were placed beneath the rear boiler overhang and occupy a space but 54" in dia. by 33" high! (Another Wing unit occupies a similar space 45"x30".)

Compact design is but one of the many superiorities of the Wing Turbine Blower. In addition, they are quiet, rugged in construction, economical in operation and in maintenance. Wing Turbine Blowers cost nothing as a source of power when the oil free exhaust steam is used for process work, space heating or other uses requiring low pressure steam.

WING MOTOR DRIVEN Axial Flow BLOWERS are used on many of the country's leading makes of boilers as standard equipment. The reason lies in the consistently satisfactory performance they have been delivering for over half-a-century—plus the outstanding features of WING design, such as volume control (Voltrol Vanes) for capacity regulation down to 90%, ease of installation, quiet operation, compact construction, low maintenance cost. Wing Motor Driven Blowers give day-in-day-out, year-in-year-out satisfaction.

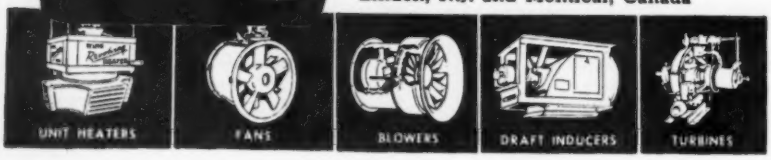


Type R Wing Turbine Blower

Write for a copy of Wing Bulletin SW-52

Wing

L. J. Wing Mfg. Co.
50 Vreeland Mills Road
Linden, New Jersey
Factories:
Linden, N.J. and Montreal, Canada



More APPOINTMENTS

Begins on page 260

The appointment of the Standard Brass & Mfg Co, 1557 Texas Ave, Shreveport, Louisiana, as a distributor of industrial tube fittings and tube fabricating tools manufactured by **The Parker Appliance Co,** Cleveland, is announced. Appointment of Just Equipment & Supply Company Ltd, 173 Colborne St, Montreal, Quebec, Canada as industrial and marine distributor for Nordberg Type 4FS Diesel engines in the Province of Quebec is announced by **Nordberg Mfg Co.**

Orr & Sembower, Inc, Reading, Pa., has announced the appointment of The Combustion Equipment Co, 4809 N Claremont Ave, Chicago as its distributor in the Chicago territory. **Formsprag Co,** Detroit announces the termination of a five-year sales agreement with the Morse Chain Co for the distribution of Formsprag clutches. A staff of Formsprag sales engineers will now service the manufacturers of machinery, power transmission units, motor vehicles, and airplanes using Formsprag overrunning, backstop, or indexing clutches.

New Names, Purchases, Addresses, etc.

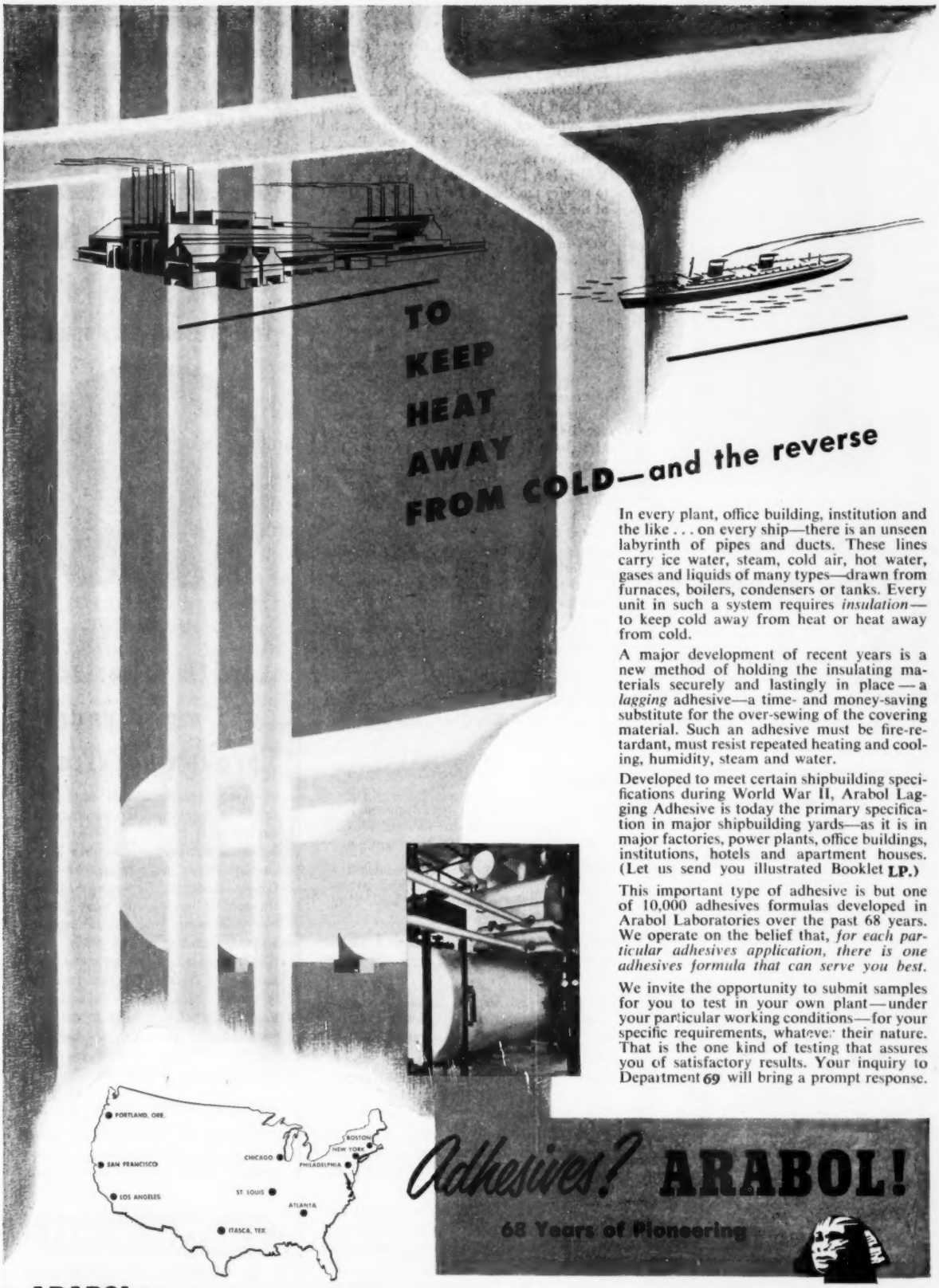
Rockland Light and Power Co, with head offices at Nyack, N. Y., has purchased the adjoining Rockland Gas Co, Inc. **The Ric-wil Co** will move into a new office at 215 East 37th Street. John F Hanbury, former New York district representative for Warren Webster & Co becomes manager of the new office, with Carl G Mencke as assistant manager. Warren Webster & Co will continue its office at 95 Madison Avenue with Kenneth C Steeneck as the new district representative.

Mathematical Compating Service, 105 Court St, Brooklyn 2, N. Y., has organized a group devoted exclusively to applied mathematics. Specializing in performing services for industries and universities desiring engineering calculations, charts and nomographs of a high degree of complexity and the treatment of related mathematical problems in the field of power engineering, the staff consists of consultants holding Doctorate degrees who are qualified to treat problems in applied mathematics related to the physical sciences.

A new warehouse and repair service operation for **Viking Rotary Pumps** will open March 1 at Atlanta, Georgia. C W Downing, head of the Atlanta office, will continue as manager of this new service located at 1214 Spring St, N.W., Atlanta. The **Sims Pump Valve Co** has moved to their recently purchased plant at 1314 Park Ave, Hoboken, New Jersey. Dr. Lawrence W Bass, nationally prominent industrial research executive, has recently become associated with **Arthur D Little, Inc,** consulting research and engineering firm of Cambridge, Mass. The **Electric Products Co,** announces the establishment of the E P Switchboard and Control Division. G J Doss has been named general manager of this new Division.

Societies, Schools, Awards, etc.

Edward C Huerkamp, manager of the



In every plant, office building, institution and the like . . . on every ship—there is an unseen labyrinth of pipes and ducts. These lines carry ice water, steam, cold air, hot water, gases and liquids of many types—drawn from furnaces, boilers, condensers or tanks. Every unit in such a system requires *insulation*—to keep cold away from heat or heat away from cold.

A major development of recent years is a new method of holding the insulating materials securely and lastingly in place—a *lagging* adhesive—a time- and money-saving substitute for the over-sewing of the covering material. Such an adhesive must be fire-retardant, must resist repeated heating and cooling, humidity, steam and water.

Developed to meet certain shipbuilding specifications during World War II, Arabol Lagging Adhesive is today the primary specification in major shipbuilding yards—as it is in major factories, power plants, office buildings, institutions, hotels and apartment houses. (Let us send you illustrated Booklet **LP.**)

This important type of adhesive is but one of 10,000 adhesives formulas developed in Arabol Laboratories over the past 68 years. We operate on the belief that, *for each particular adhesives application, there is one adhesives formula that can serve you best.*

We invite the opportunity to submit samples for you to test in your own plant—under your particular working conditions—for your specific requirements, whatever their nature. That is the one kind of testing that assures you of satisfactory results. Your inquiry to Department **69** will bring a prompt response.

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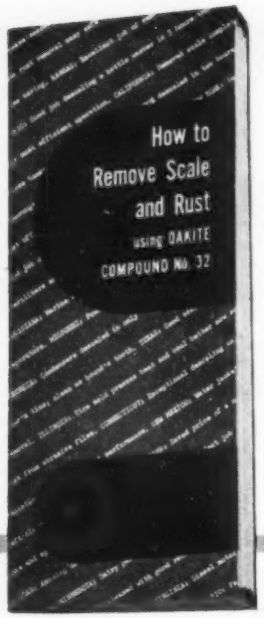

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More APPOINTMENTS

Begins on page 260

application engineering department of the Westinghouse Electric Corp's Lighting Div, has been named chairman of the executive committee of the **National Street and Traffic Lighting Safety Bureau.** Everett N McDonnell, president of McDonnell & Miller, Inc, Chicago, Ill., has been selected to receive the 1952 F Paul Anderson Medal of the **American Society of Heating and Ventilating Engineers** "for outstanding work in the field of heating, ventilating and air conditioning," it is announced.

Dr Max Jakob, research professor of mechanical engineering at Illinois Institute of Technology, has been awarded the Worcester Reed Warner medal by the **American Society of Mechanical Engineers,** "for his outstanding contributions to science and engineering, particularly in the fields of thermodynamics and heat transfer." The 80 manufacturers of the nation's material handling equipment have elected Howard M Palmer of Lewis-Shepard Products Inc, Watertown, Mass., as president of **The Material Handling Institute** for 1953. Dr Ralph G Owens, dean of engineering at Illinois Institute of Technology, has been named vice chairman of the Illinois-Indiana section of the **American Society for Engineering Education.**

American Leather Belting Association elected the following officers to serve for the year 1953: president, Philip G Rhoads, a partner of J E Rhoads & Sons of Wilmington, Delaware; vice-president, Wm F MacDonald, president of E F Houghton & Co of Philadelphia, Pa; treasurer, Arthur H Rahmann, president of Geo Rahmann & Co of New York; executive vice-president and secretary, E R Rath.

Obituaries

Henry J Sandblade, consulting engineer and vice-president of the Thomas Flexible Coupling Co, January 5, in Climax, Colo.

Frank M Mason, 42, vice-president of U. S. Electrical Motors, Inc, and general manager of the company's Milford, Conn. plant, on December 27.

Charles H Currier, 66, chairman of the board of Kewanee-Ross Corp, December 22, in Buffalo, N. Y.

Arthur R Smith, 73, former managing engineer of the General Electric Co's turbine-generator division, January 1, in Schenectady, N. Y.

Robert J. Weber, 58, assistant district manager of the Westinghouse Electric Corp's central sales district, December 28.

Herbert E Sawyer, 74, a director and recently retired vice-president and treasurer of Macwhyte Co, of Kenosha, Wis, December 28 in Hollywood, Fla.

Henry Ward Beecher, 70, prominent consulting engineer of Seattle, Wash, and grandson of the famous clergyman whose name he bore, January 8 in Seattle.

Raymond W Vonasch, 40, manager of federal and marine sales for Ward Leonard Electric Co, Mount Vernon, N Y, Dec 2.

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MODERN DESIGN
for present-day needs

...with a heritage of "many years proven service"

Lonergan Pressure Gauges have maintained a reputation for accuracy and dependability in power plant and other industrial services for more than half a century. Now, you can get Lonergan Gauges made to this established high standard of quality with many distinctive refinements and design improvements for meeting modern needs. More than 100 types and 16 Case styles. Sizes range from 2½ to 12 inches. Lonergan representatives located in important industrial centers are ready to help you meet specific problems. Or call the Lonergan distributor nearest you. They are located in over 200 cities.

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Illustrations and full details are available to you in our Pressure Gauge Catalog. Write for it on your business letterhead.

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PROSPERITY IN THE USA: How Deeply in Debt Are We?

How prosperous *are* the people of the United States? Previous messages in this special series have answered this question in part by recording the progress—relatively slow progress—we have made in increasing both the income and the wealth per person in the USA.

This fourth and concluding piece of the special series deals with the extent to which our prosperity should be discounted because it has been accompanied by an increasing volume of debt. Many correspondents have suggested to us that an individual or a nation can temporarily increase prosperity by borrowing, but in so doing lives on both borrowed goods and borrowed time. Our purpose here is solely to throw light on the question of whether or not we are now in that unenviable position.

On January 1, 1953, the total debt of the United States government and of its citizens was $627 billion, as shown in the table below. On its face, a debt of this magnitude, which represents about $3,900 of debt for each person, suggests that we are heavily debt-ridden.

TOTAL DEBT – PUBLIC AND PRIVATE

Federal government debt	$267 billion
State and local debt	30 "
Private debt	
Corporations	195 "
Individuals	135 "
	$627 billion

The burden of our debts, however, does not depend simply on their size. It depends in much more decisive degree on our capacity to carry the load successfully. This capacity, in turn, is partly a matter of attitude, and attitudes defy objective measurement. A community that gets very jittery about its debts has less capacity to carry its burden successfully than one that does not. But the accurate measurement of jitters, present or prospective, still remains to be mastered.

Capacity to Carry the Debt Load

Nonetheless, it is possible to throw some light on our capacity to carry the debt burden by studying key economic elements that can be measured with some degree of accuracy. The following paragraphs indicate how some of these key economic elements stand.

Compared with our national income, the total volume of our debts, public and private, is still well below the level of 1929, when it proved to be too big for the good of the country. Our total debt is now 113% greater than the national income whereas in 1929 it was 146% greater.

There are several other cheering facts about our debts. One is a sharp decline in interest rates which makes the cost of carrying our debts relatively much less than it was in 1929. It took 8% of our total national income to carry our debts in 1929; it takes only about 5% of the income today.

More Cheering Facts

We also have much more ready cash now than in 1929. Today individuals and corporations hold a total of $269 billion in cash or its equivalent which is almost twice as much as the portion of private short-term debt (about $140 billion) that is subject to sudden demand for payment.

Many students of the subject cite the relatively low cost of carrying our debts and the large volume of cash on hand, and reach the comfortable conclusion that our debt burden is nothing to worry about. In further support of this view they emphasize the fact that no important part of our debt is owed abroad. Hence, they reason there is not the danger, so conspicuous in Britain since the end of World War II, that our economy will be upset by the necessity of making heavy debt payments to other countries.

Some Dangers of Present Debt

However, the nature of our debts presents dangers that it would be foolish to ignore. This is true of both the debt of $267 billion owed by the federal government to its citizens and the $330 billion in private debts owed by some citizens and corporations to others.

Public debt can be a dangerous kind of debt because government has the power to print money or to create its equivalent by expanding bank credit. Of the $215 billion that the federal government borrowed during World War II, over $90 billion was borrowed from banks. This was the largest single contributor to the inflation of prices that since the war has robbed the dollar of about half of its purchasing power, and thereby robbed the buyers of government bonds of about half the purchasing power these bonds were supposed to represent.

If, as is quite possible, a new emergency should again require the federal government to borrow heavily while its debt remains so high, it is doubtful that the public would be avid to buy its bonds. Hence, the government might again be forced to resort to the inflationary process of relying on bank credit.

Private debts can be dangerous if the people take on new debts more rapidly than is justified by the growth of business or by their ability to repay. Last year bank loans were increased by the imposing sum of about $6½ billion, which represents an increase of about 11% in total loans outstanding. This is almost twice as much as the increase in the volume of business over the same period. Installment credit for consumers increased by $3 billion last year, again an increase in debt about twice as great as the increase in business volume in the fields where the credit was used. It is also the fastest rate of such growth in our history.

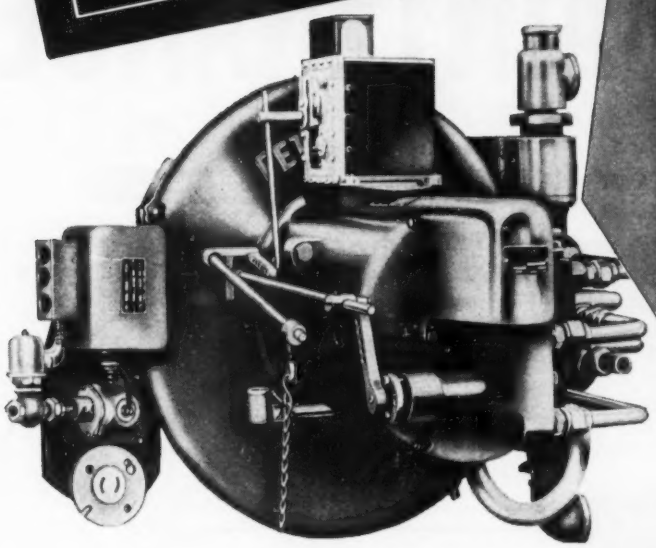
Constructive Use of Credit

So long as the expansion of credit does no more than keep pace with expansion in the volume of business, the expansion is constructive. Also, when credit is expanded to acquire resources and equipment that will enlarge the volume of business a little later, that use is clearly constructive. But when private credit expansion begins to run ahead of business growth, it is time for us to be heads up. Such credit expansion courts price inflation. It also creates a forced draft under business so that, if credit is cut off, there may be a painful drop.

To give a summary answer to the question: *Is the level of debt in the United States a danger to our prosperity?* — the answer seems to be, "Not at the moment." We owe nothing abroad. The interest burden on present debt is relatively small, and we appear to have the resources to handle the short-term debt. Yet both the total amount of debt and the recent rapid increase in total private debt, especially the latter, are enough to signal for caution. We need restraint on the part of business and consumers to avoid expanding private borrowing at an excessive rate. The federal debt needs to be reduced and put in more manageable form. If these things are done, we can proceed to build a sound prosperity.

McGraw-Hill Publishing Company, Inc.

Are steam costs YOUR responsibility?



MODERNIZE WITH A **Petro** INDUSTRIAL OIL BURNER

and cut steam costs!

HERE'S WHAT PETRO WILL DO FOR YOU:

LOW FIRST COST

Petro industrial oil burners are designed and built to *modernize* the firing of your present boilers. This means that you save substantially on initial installation costs—yet enjoy the efficiency, the dependability, and the complete automatic operation that has been traditional with Petro burners for over 50 years.

LOWER FUEL COSTS

A Petro oil burner's economy is unchallenged. You save two ways. First, you save on fuel cost, because heavy oils cost less per gallon and have higher heat value. And second, a Petro burner is designed to burn these low-cost, heat-rich heavy oils with complete dependability. Whether the oil is thick or thin a Petro feeds it steadily under precise automatic control. You get more efficient firing.

UNUSUAL FLEXIBILITY

Here is another Petro value. Under automatic modulating flame control it is extremely flexible in following fluctuating steam demands. If yours is a problem of "high and low" steam requirements—than a Petro burner is your answer. It follows the load without hesitation, and throttles down to a steady low burning rate if desired.

LOWER OPERATING COSTS

Petro Industrial Oil Burners are completely automatic. They require a minimum of supervision. Boiler rooms stay clean. The simple, sturdy design of the Petro burner and its easy accessibility reduce upkeep to a minimum—save you money year after year.

Leading heating contractors everywhere recommend and install Petro oil burners. See your contractor, or mail coupon below.

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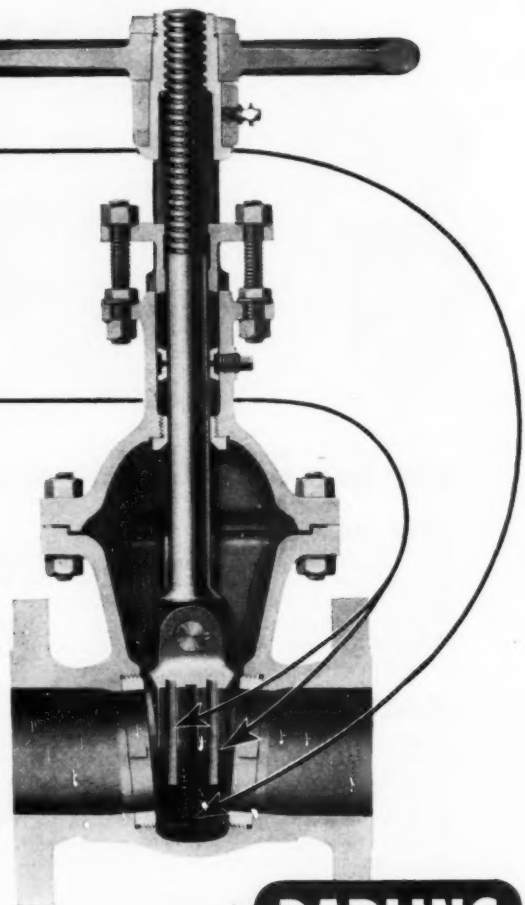
How Darling Cast Steel Gate Valves

AVOID TROUBLE REDUCE MAINTENANCE



SLOTTED WEDGE

Allows compression of the wedge. Compensates for valve body expansion or contraction due to temperature changes. Thus tight closing and easy opening are assured, with far less wear and tear on wedge faces and seats.

DOUBLE-GROOVED WEDGE

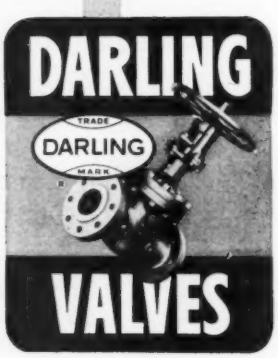
Double grooves, with corresponding twin ribs in valve body, provide twice the usual bearing area for lasting, trouble-free alignment. Eliminates wedge canting, due to line pressure, preventing damage to downstream seat.

These are only two of the many "ounces of prevention" built into Darling valves. They always add up to gate valve performance at its low-cost best! Give Darlings a chance in *your* service and you'll see for yourself. The 300-page Darling Catalog No. 17M, full of data of general value and description of Darling valves of *all* types, is yours for the asking.

Darling Gate Valves, noted for outstanding quality, strength and precision, are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds. In addition to the slotted wedge types, there are solid wedge taper seat valves and the famous Darling Fully Revolving Double Disc Parallel Seat Gate Valves for virtually any service.

FOR PLUS VALUES,

JOB-PROVED AGAIN AND AGAIN . . .

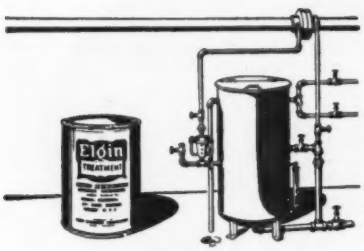


DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

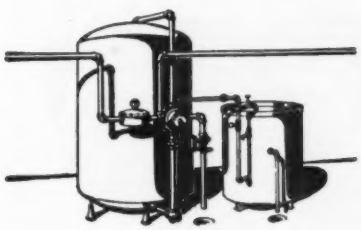
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Which of these methods will best fit your water conditioning needs?



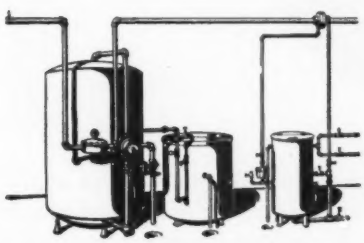
1 CHEMICAL FEED

In many cases, individually prepared Elgin Chemical Treatment alone will effectively prevent scale formation and corrosion.



2 ZEOLITE SOFTENING

A zeolite water softener will efficiently eliminate hardness, scale, and lime deposits.



3 ZEOLITE – POST TREATMENT

A zeolite softener, supplemented by chemical treatment will not only eliminate hardness, but will also prevent corrosion.

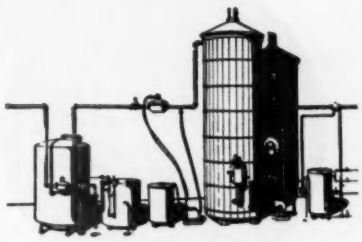
FOR AN UNBIASED ANSWER . . . CALL YOUR ELGIN MAN

Chances are that one of these basic Elgin systems will fit your water conditioning needs. If not, there is no limit to the number of systems we can "tailor" to your exact requirements and budget.

Whether a simple chemical feed system, a zeolite water softener, one of the many ion-exchange combinations, silica and CO_2 removal, or deionization for the highest quality water known today — you may be sure Elgin can provide the type of system required to produce water of the exact characteristics you require.

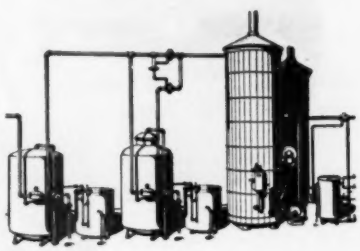
Nearly a half century of water conditioning experience is yours for the asking

Most important is the fact that Elgin's skill and experience, gained through nearly a half century devoted exclusively to the field of water conditioning, is yours for the asking — through our district engineer in your vicinity. Write, wire or phone, and we will put him in touch with you.



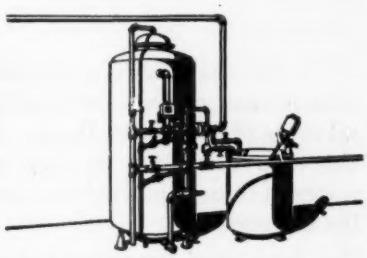
4 ZEOLITE – ALKALINITY NEUTRALIZATION

Water of low-controlled alkalinity, with CO_2 removed, can be produced by acid feed and degasification following zeolite softening.



5 SODIUM – HYDROGEN SOFTENING AND DEGASIFICATION

Blended effluents from a sodium zeolite softener and a hydrogen zeolite softener, followed by degasification, give water in which total solids and alkalinity is reduced and CO_2 is removed.



6 DEIONIZATION INCLUDING SILICA AND CO_2 REMOVAL

Single-tank Ultra-Deionizer produces the equivalent of distilled water, free from silica and CO_2, at amazingly low cost.

ELGIN
SINCE 1908
WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois

WARREN PUMPS

keep their heads!

. . . . . in other words, *maintained efficiency* has always been, and will continue to be, a fundamental virtue of all Warren Pumps. *Original* efficiencies in a pump can be very misleading and a source of disappointment in its long range efficient life expectancy.

The three most important factors affecting maintained efficiency are hydraulic design, leakage losses and friction losses. The generous acceptance of Warren Pumps for well over half a century is convincing evidence that Warren has the engineering ability, skilled pump mechanics, and plant facilities to handle all of these important factors to the definite advantage of their customers, from the angle of longe-range efficiency, minimum wear, and low power costs.

"THEY KEEP THEIR HEADS"

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

G-1

WARREN QUIMBY PUMPS

WARREN PUMPS

CENTRIFUGAL • RECIPROCATING • ROTARY

Stud-and-Nut Combination Resists Fatigue Failure

-------Stays on Job at HIGH Temperatures

For bolting applications involving high temperatures or high pressures, it pays to use the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts.

This stud-and-nut combination is ideal for difficult bolting jobs because it resists the premature fatigue failure often induced by fluctuating temperatures and pressures. It's an economical combination, too, because of its long service life.

The Bethlehem Continuous-Thread Stud has no point of thread-runout. Therefore those stresses which could contribute to early failure are well distributed over the full working length of the stud, rather than being allowed to gather at any one point.

The Bethlehem Quenched Nut, made from .40 to .50 carbon steel, is formed by forging and extruding hot steel in a forming die. It is then quenched and tempered. This procedure makes the nut sufficiently strong to break virtually any stud or bolt on which it may be used. Like its companion stud, the Quenched Nut is furnished in a wide range of sizes.

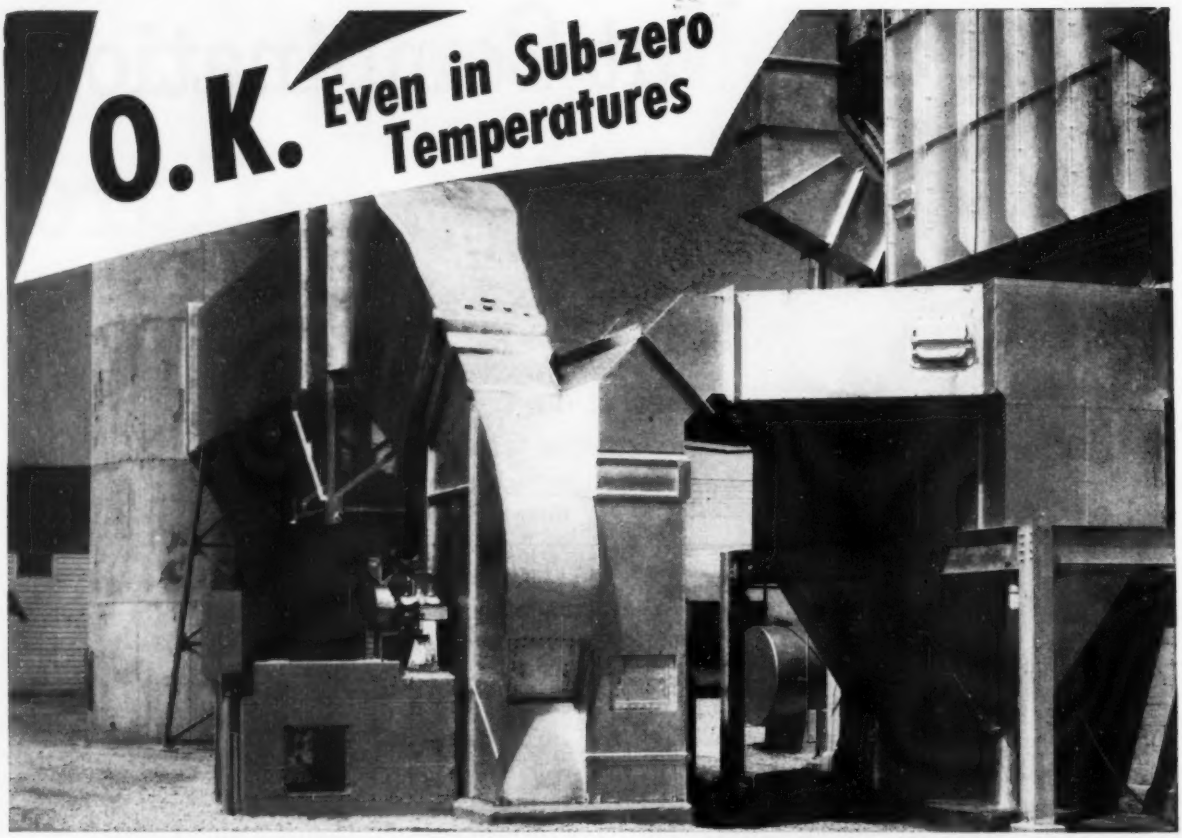
It will be well worth your while to consider Bethlehem Continuous-Thread Studs and Quenched Nuts for high-temperature bolting. The nearest Bethlehem office is at your service.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Bethlehem supplies every type of Fastener



CLARAGE FANS Selected for First Outdoor Station in Head-of-the-Lakes' Area

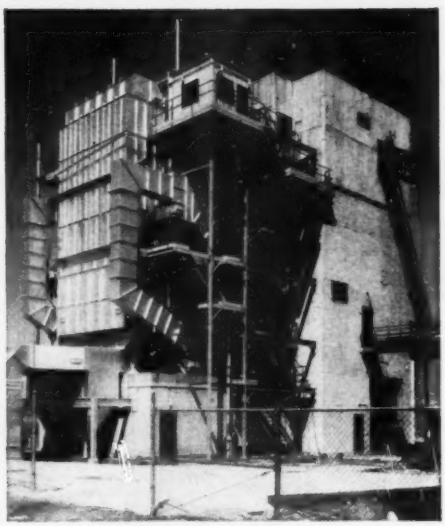
Above is a Clarage Type RT Fan furnishing induced draft for a Riley Steam Generating Unit in Superior, Wisconsin — a recently completed 12,650 KW extension to the Winslow Station of the Superior Water Light & Power Company. Forced draft is also supplied by Clarage.

Here is a completely outdoor installation located where winter temperatures of 30 to 40 degrees below zero are not exceptional. **Unprotected equipment to function properly in such a rigorous climate must be good!**

Through past experience Ebasco Services, Inc. (the consulting engineers), Riley Stoker Corporation, and this great public utility KNEW that they could depend on Clarage fans — and time will prove that their choice was well founded.

Yes, regardless of operating conditions, you can RELY on CLARAGE to provide economical performance for a long time to come.

CLARAGE FAN COMPANY, 615 PORTER, KALAMAZOO, MICH.



New extension to the Winslow Station of Superior Water Light & Power Company which includes steam temperature control, water-cooled furnace and steel-clad instrument setting.

You can Rely on...

CLARAGE

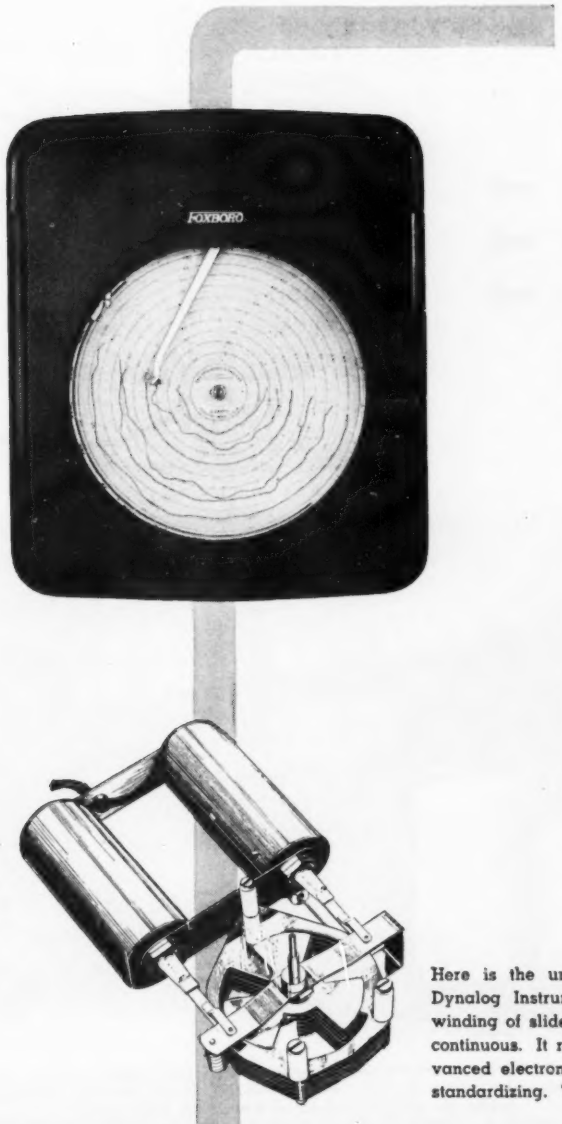
Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA Canada Fans, Ltd., 4285 Richelieu St., Montreal

No other instrument

for recording pH or conductivity

offers this cost-saving combination



1. Six-point recording on a single round chart

2. Freedom from slidewire limitations

HERE'S THE IDEAL MEANS of recording pH and conductivity in boiler water, condensate, make-up water and circulating water. The Foxboro Multi-Record Dynalog* can measure and record up to 6 points on conductivity . . . or 6 points on pH (with only 1 pre-amplifier). It uses convenient circular charts . . . easy-to-read, economical-to-use. A substantial saving in initial cost of instruments is also assured.

IN ADDITION, Dynalog Instruments have *no slidewire*, no contacts to stick, wear or corrode. Maintenance is practically eliminated. Because of their completely electronic design, these instruments offer new standards of sensitivity, speed and accuracy . . . proven process improvers, cost-savers and trouble-savers. Here's your opportunity to step up plant operating efficiency. Write for detailed Bulletin 430-1. The Foxboro Company, 683 Neponset Ave., Foxboro, Mass., U. S. A.

*Reg. U. S. Pat. Off.

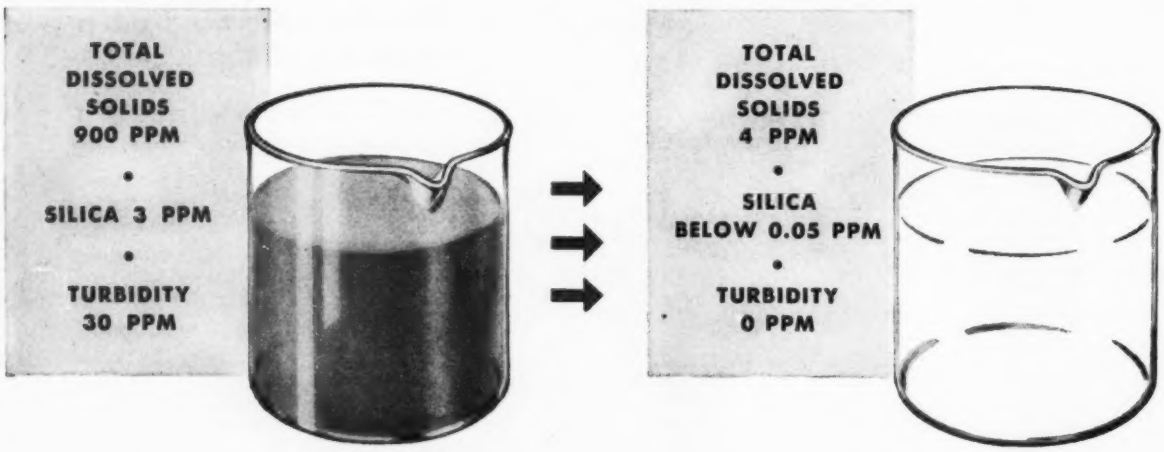
Here is the unique, simple rotary-capacitor balancing device of Dynalog Instruments. Its sensitivity is not limited by turn-to-turn winding of slidewire. Balancing is completely STEPLESS as well as continuous. It requires no high speed motor, no galvanometer. Advanced electronic design also eliminates dry cell batteries . . . no standardizing. The simplest potentiometer ever built!

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

FACTORIES IN THE UNITED STATES CANADA, AND ENGLAND

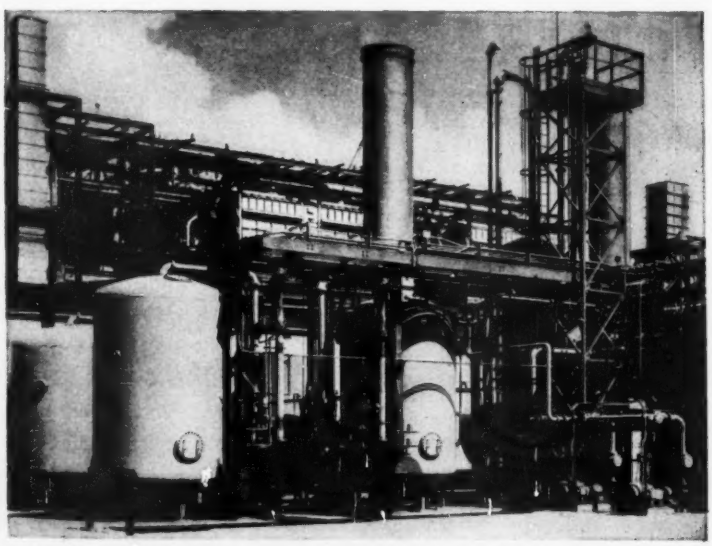
A Graver Demineralizer makes the difference



This Graver demineralizer installation had to tackle a *doubly* tough water purification problem . . . extreme hardness plus turbidity. And 600 gpm has to be treated.

But the Graver plant is combining demineralizing plus filtering of this large demand with complete success. In addition, a Graver Vacuum Deaerator following the Demineralizer completely eliminates CO_2 and reduces the oxygen below 0.2 ppm. As a result, the effluent is ideally suited for the high pressure boilers served by the Graver installation.

For similar success in solving *your* water treatment problem, investigate Graver's proven modern equipment designs based on over 40 years of specialized experience and pioneering in every water treating process. Your request for recommendations will involve no obligation.



Double train, two-bed Graver Demineralizer installation at a large southwestern chemical plant, treating 864,000 gallons per day of raw water for 450,000 pounds per hour, 1250 psig boilers.

GRAVER WATER CONDITIONING CO. GRAVER

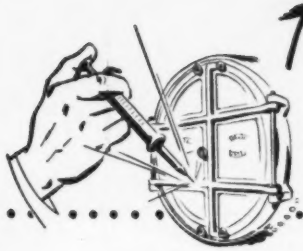
Division of Graver Tank & Mfg. Co., Inc.

DEPT. P-D, 216 WEST 14TH STREET, NEW YORK 11, N. Y.

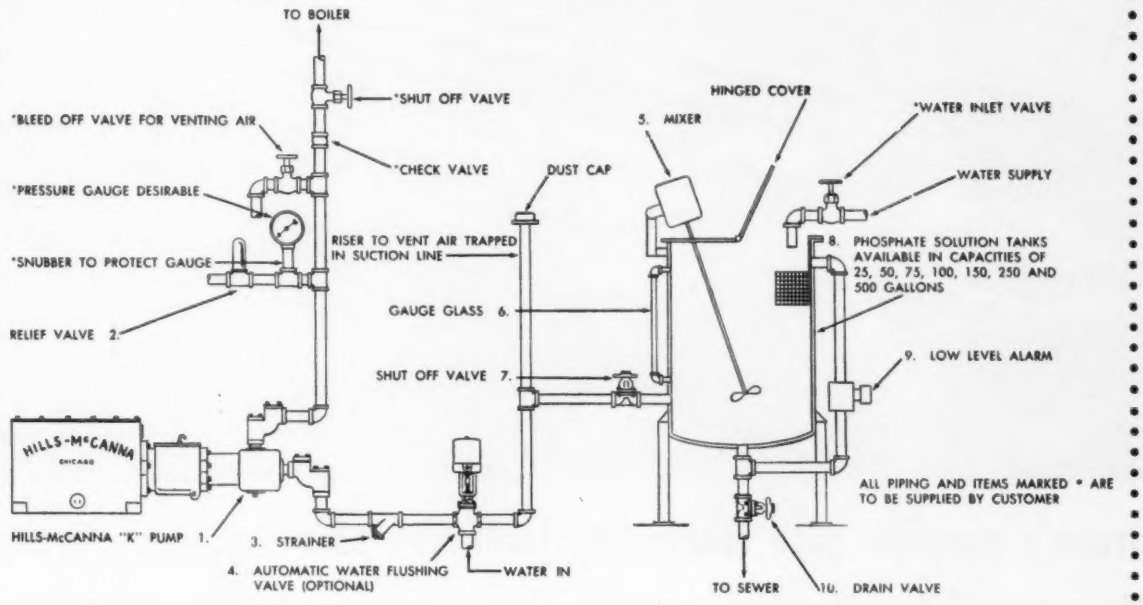
In Canada: The Bird-Archer Co., Ltd., Cobourg, Ontario
In Mexico: Proveedores Tecnicos, S.A., Puebla 259, Mexico 7, D. F.

GW 470

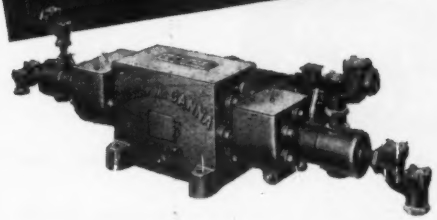
Here's a "packaged" system



FOR TROUBLE-FREE PHOSPHATE BOILER TREATMENT


TO BOILER
*SHUT OFF VALVE
*BLEED OFF VALVE FOR VENTING AIR
*CHECK VALVE
DUST CAP
*PRESSURE GAUGE DESIRABLE
*SNUBBER TO PROTECT GAUGE
RISER TO VENT AIR TRAPPED IN SUCTION LINE
RELIEF VALVE 2.
GAUGE GLASS 6.
SHUT OFF VALVE 7.
HILLS-McCANNA
CHICAGO
HILLS-McCANNA "K" PUMP 1.
3. STRAINER
4. AUTOMATIC WATER FLUSHING VALVE (OPTIONAL)
WATER IN
HINGED COVER
5. MIXER
*WATER INLET VALVE
WATER SUPPLY
8. PHOSPHATE SOLUTION TANKS AVAILABLE IN CAPACITIES OF 25, 50, 75, 100, 150, 250 AND 500 GALLONS
9. LOW LEVEL ALARM
ALL PIPING AND ITEMS MARKED * ARE TO BE SUPPLIED BY CUSTOMER
TO SEWER
10. DRAIN VALVE

featuring
HILLS-McCANNA metering and proportioning pumps



Now you can get an engineered phosphate boiler feedwater treatment system in a complete "package". The package consists of a Hills-McCanna metering pump, solution tank and all auxiliary fittings other than those which are normally carried in stock or are readily available.

A similar packaged system is available for sulphite treatment, and, like the phosphate system, is built around a tried and proven Hills-McCanna metering pump.

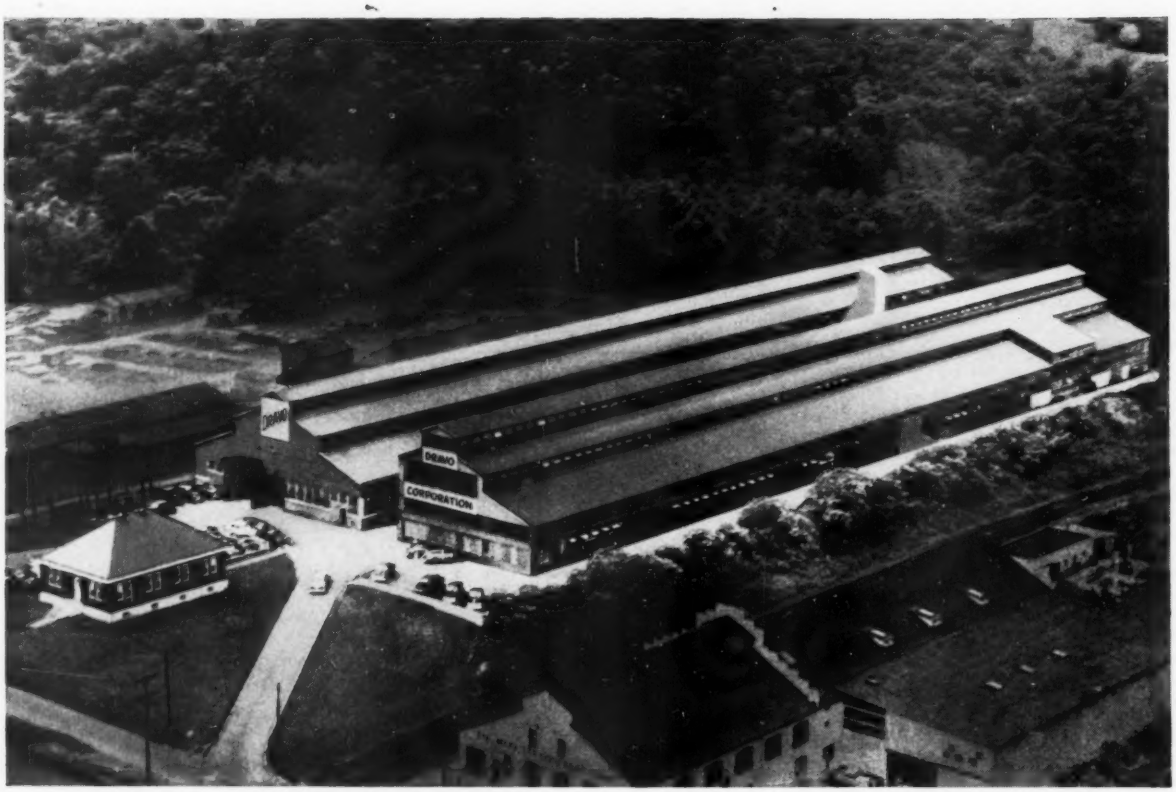
Further information on either system or complete descriptive literature on Hills-McCanna metering and proportioning pumps will be furnished on request. HILLS-McCANNA CO., 2369 W. Nelson St., Chicago 18, Illinois.

HILLS-McCANNA

metering and proportioning pumps

ALSO MANUFACTURERS OF

SAUNDERS PATENT DIAPHRAGM VALVES • FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS



Dravo's complete pipe fabricating facilities—*plus*—at your service

What's unusual about Dravo's pipe fabricating services? Simply this: Dravo's Pipe Fabricating Shop at Marietta, Ohio, is one of the largest in the country . . . well staffed with qualified personnel who have years of experience and "know-how" . . . offering you the benefits of modern facilities and prompt delivery of a product made to your exact specifications. What's more, Dravo can erect a complete power installation.

Dravo's modern shop specializes in all phases of fabrication, such as automatic machine welding . . . stress-relieving furnace, electric stress relieving and heat treatment . . . pipe bending . . . gamma-ray and X-ray testing . . . drafting service and code familiarity.

Dravo has supplied the fabricated pipe in many of the major power plants all over the country. Why not find out how Dravo can be of service to you? Write today for complete information. Ask for Bulletin No. 1700.

DRAVO CORPORATION, Fifth and Liberty Avenues, Pittsburgh 22, Pennsylvania.

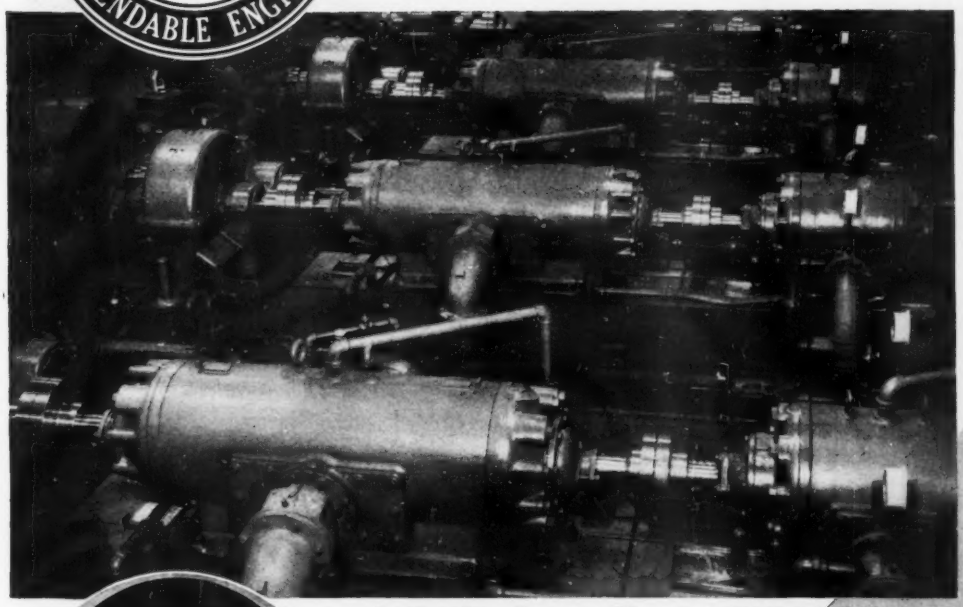
THIS *too* IS DRAVO

Air conditioning • boiler and power plants • bridge sub-structures • compressor and pumping stations • crane cab coolers • docks, locks and dams • dredging • gantry and floating cranes • industrial foundations • marine repairs • open steel flooring • ore and coal bridges and unloaders • pipe prefabrication and erection • pump houses and intakes • ready-mixed concrete • river sand and gravel • river transportation • slopes, shafts and tunnels • space heaters • steel shipping containers • towboats and barges • water and waste treatment plants • DRAVO

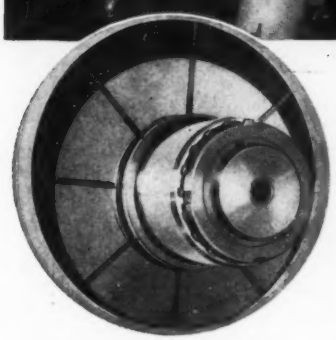
PRATT & WHITNEY AIRCRAFT

DEPENDABLE ENGINES

PRATT & WHITNEY AIRCRAFT



Four Fuller Rotary Compressors, Elliott steam-turbine driven, have a total capacity of 6760 c.f.m., at 110 p.s.i.



depends on FULLER AIRPOWER

Four Fuller Rotary Two-stage Compressors put Pratt & Whitney Aircraft's engine plant in East Hartford on a 100 p.s.i. air diet for such operations as shot peening, spray booths, air cleaning, and air-operated chucks.

Pratt & Whitney Aircraft has joined no *small* family of users; food and chemical plants, steel mills and cement mills, gas-gathering plants, refineries, automobile plants, foundries and machine shops, public utilities, and many others depend on Fuller for compressor equipment, wherever air is required.

Whether *your* air-plans call for single-stage, two-stage — single-stage duplex or two-stage duplex—you can be sure Fuller has the compressors which gives you a dependable source of pulsation-free air up to 3300 c.f.m., 125 p.s.i., with maintained capacity for the life of the machine.

Write for Bulletin C-6, Fuller Rotary Compressors.

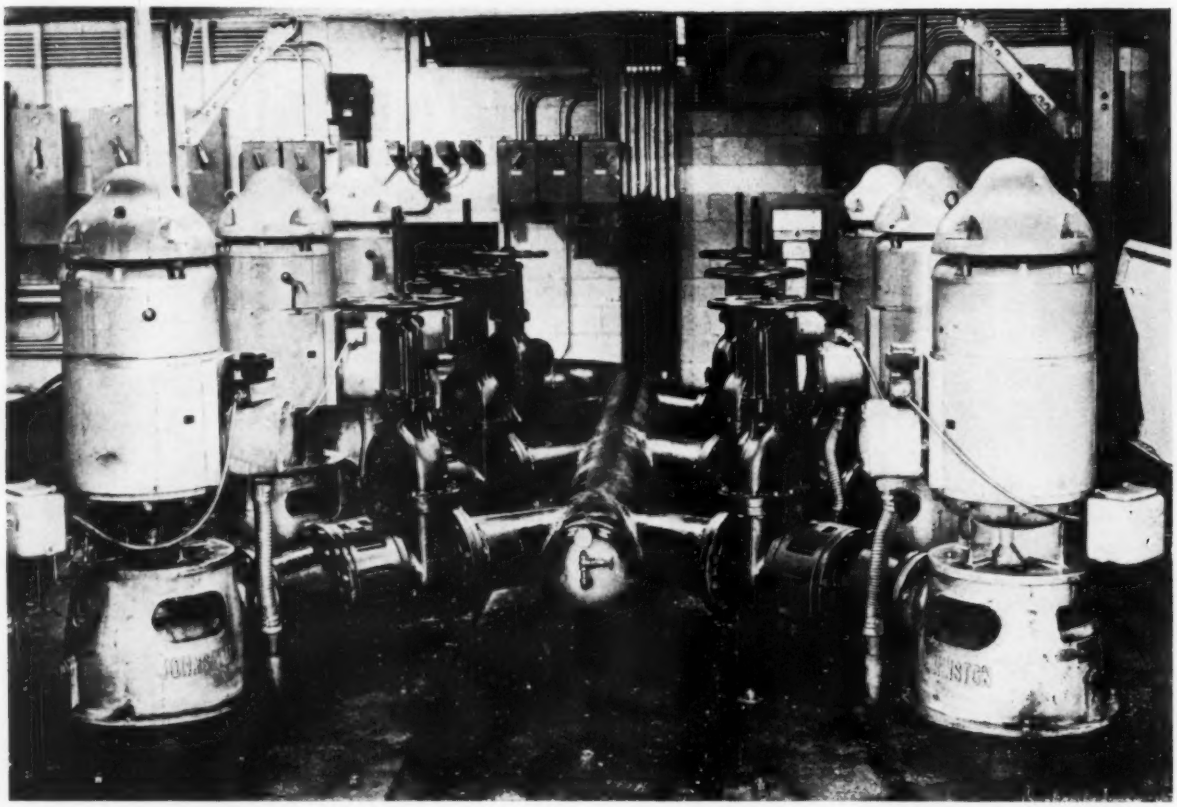
FULLER COMPANY, Catasauqua, Pa.
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

C-225
1624

In small plants and large...



JOHNSTON VERTICAL TURBINE PUMPS ARE HANDLING CRITICAL JOBS IN MANY INDUSTRIES

For example, take the six Johnston Close-Coupled Pumps shown here which are installed at the Gear and Axle Division of one of the BIG THREE auto manufacturers.

Each of these units is pumping cutting oil with a specific gravity of .833—with a viscosity rating of 85 S.S.U. at 100 degrees Fahrenheit . . . and they are doing it at the rate of 2,000 gallons per minute against a 100 foot head. Rated at 60 H.P., these are 2-stage, 14 inch pumps equipped with cast iron semi-open impellers and cast iron bowls. Both bowls and impellers are coated with vitriform porcelain enamel.

This is just another typical example of the ability of Johnston equipment to handle all types of pumping jobs in plant operations, large or small. Why not let our trained engineering staff consult with you on the best solution to YOUR particular problem?

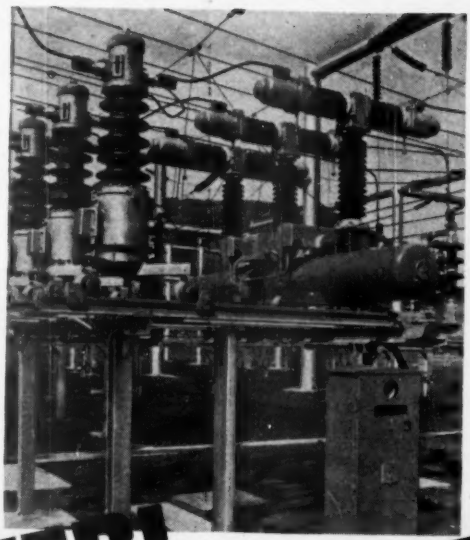
Send today for your free copy of our new bulletin describing Johnston Close-Coupled, Vertical Turbine Pumps designed for industrial service. Ask for Bulletin G-33.

JOHNSTON
VERTICAL PUMPS

JOHNSTON PUMP COMPANY

3272 E. FOOTHILL BLVD., PASADENA 8, CALIFORNIA

there's more to a BROWN BOVERI AIR BLAST BREAKER than meets the eye...



Built into every Brown Boveri Air Blast Breaker are *plus values* that make these basic factors possible . . .

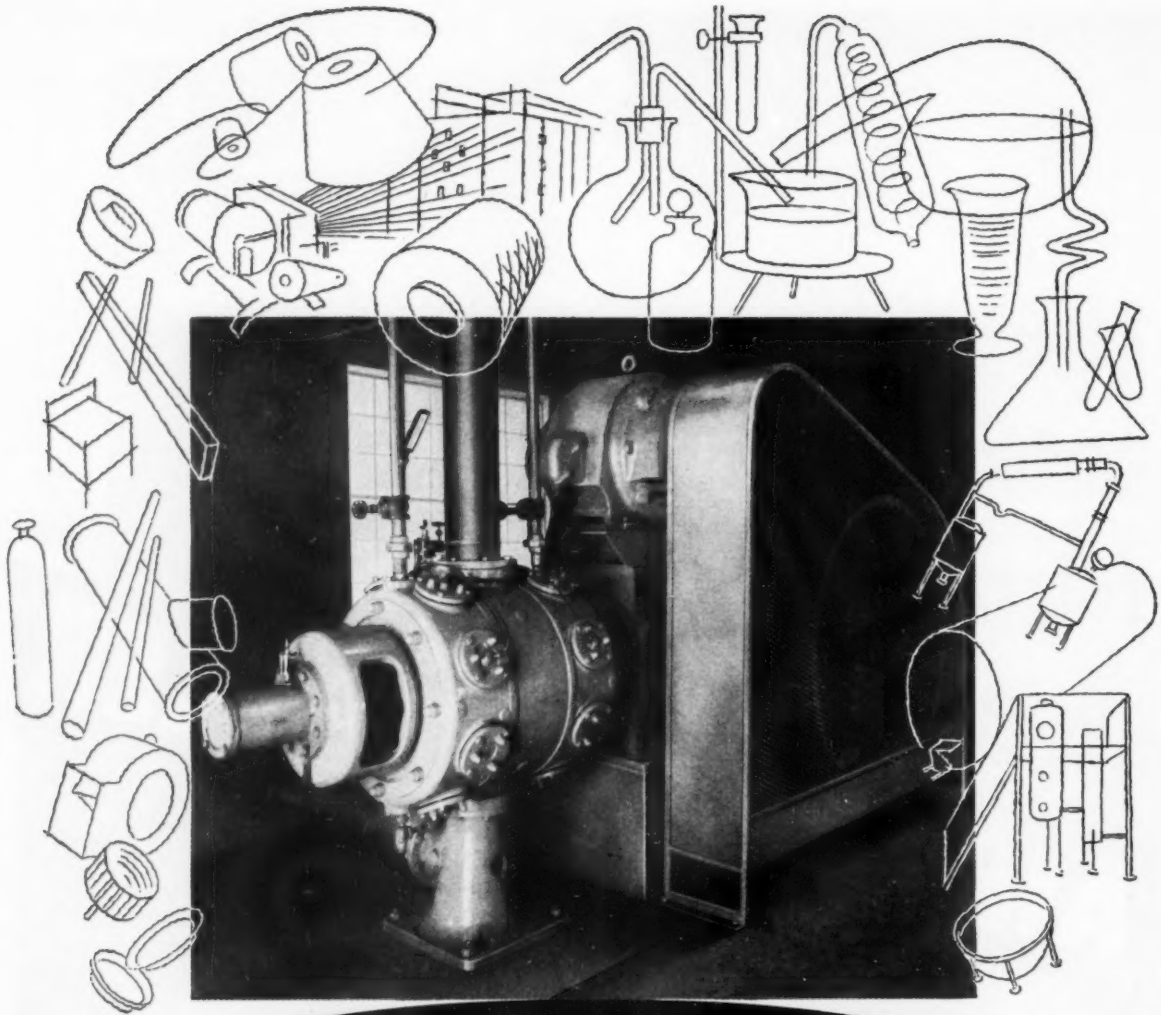
1—HIGH SPEED
2—POSITIVE INTERRUPTION UNDER ALL CONDITIONS
3—RAPID RECLOSING
4—AMAZINGLY LOW INSTALLATION COST
5—QUICK and EASY INSPECTION
6—MINIMUM MAINTENANCE
7—DEPENDABILITY
8—DELIVERY
9—COMPETITIVE PRICING

For these reasons . . . and many others . . . more and more utilities, cooperatives and industrial organizations are standardizing on BROWN BOVERI outdoor and indoor air blast breakers.

Facts that tell the complete story are yours for the asking. *Write for them today!*

BROWN BOVERI

BROWN BOVERI CORP.
19 RECTOR STREET, NEW YORK 6, N. Y.



Protect Products

WITH CP OIL-LESS CYLINDER COMPRESSORS

If you use air for operating instruments or if you process chemicals, beer, food or other products where oil-laden air would be a detriment, you need a Chicago Pneumatic Oil-Less Cylinder Compressor.

Available in three types, CP Oil-Less Compressors have carbon piston rings — need no oil or other lubricant. The Class T-BO illustrated above has a full-floating piston with an outboard crosshead. Piston weight is not carried by the cylinder wall or the carbon rings — rings act only as a compression seal against the hardened steel cylinder liner. A distance piece between cylinder and frame, and carbon piston rod packing prevent transmission of oil into the cylinder from the frame.

For more details, write for Bulletin 728 Supplement D.

CHICAGO PNEUMATIC TOOL COMPANY
8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

"For high dust collection efficiency CONSIDER THESE FACTS!"

95% to 99% REMOVAL

Your specific needs determine the exact percentage of fly ash removed by a Research Corporation Cottrell Precipitator.

LOW DRAFT LOSS

The pressure drop between inlet and outlet of the Cottrell is extremely low, averaging *only a few tenths of an inch of water.*

DURABILITY

Low velocities hold abrasion to a minimum.

ANY CAPACITY

Cottrell precipitators have been used successfully with both small boilers and the very large boilers developed in recent years.

OTHER APPLICATIONS

Cottrell precipitators have wide application in the recovery of other materials such as acid mist, blast furnace dust, sodium salts, fluid catalyst and valuable metals from smelters.

YOU GET all these important advantages PLUS Research Corporation's 38 years of experience in the field of electrical precipitation. Every Cottrell installation is individually engineered to do the most efficient job. For more facts about Research-installed Cottrells, send for Bulletin 500.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

Complete Facilities

...for Every Power Piping Job

Simplify your next power piping installation—turn the entire job over to P.P.&E. Here's how you benefit:

- Far less detail work for you.
- Correct interpretation of your blueprints.
- Efficient detailing of shopwork for best coordination with field requirements.
- Maximum amount of system prefabricated, stress-relieved, model-tested, as well as tested under ideal shop conditions.
- Field erection supervised by specially-trained personnel, with minimum waste motion.

And—you gain the use of the diversified practical experience with all types of high-pressure, high-temperature piping that we have acquired in 50 years of specialization in this field.

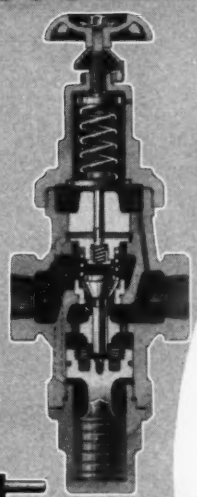
Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street — Pittsburgh, Penna.

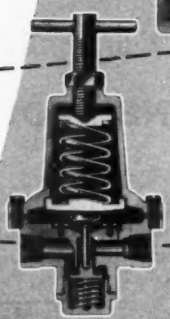
Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
785 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

FIRST STEP
IN REDUCING PRESSURE REDUCING COSTS



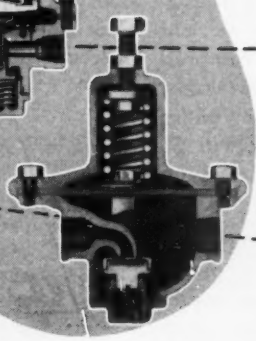
On Steam Lines Masoneilan No. 11 Reducing Valve cuts costs by holding pressures where you want them with a minimum of attention. Superfinished parts increase sensitivity, prevent sticking and corrosion. Stainless steel integral pilot, hardened stainless steel valve, chrome-nickel steel seat ring, rugged construction throughout combine to reduce maintenance to little more than keeping parts clean. Serviced in the line. Wide range of reduced pressure settings. Available in bronze, iron or steel.

ON STEAM LINES



On Air Lines Masoneilan No. 71 Reducing Valve provides accurate control with minimum maintenance. High capacity at all pressure settings. Rugged brass construction resists corrosion. May be serviced in the line.

ON AIR LINES



On Water Lines Masoneilan No. 227 avoids waste by maintaining industrial water pressure at desired point without cutting down flow. Has tight shutoff. Requires little or no maintenance. Sturdy bronze construction prevents corrosion.

ON WATER LINES

Stocked by or available through your reliable Industrial Distributor. Or write Mason-Neilan Regulator Co., 1186 Adams St., Boston 24, Mass.

MASONEILAN REGULATORS

Keep Pressure under Control

ALL HIGH Quality Coefficient PRODUCTS

Latest type Cooper-Bessemer 1500 hp opposed-action air compressor, installed in Boeing's Research Laboratory, Seattle. Capacity is automatically, accurately controlled at any discharge pressure up to 295 psig.

Over 6 million Cooper-Bessemer compressor horsepower NOW IN USE!

Modern air power on land

HELPS GAIN NEW POWER IN THE SKY!

HERE are two kinds of air power—Boeing's amazing new B-47 Stratojet, shown in a Jato takeoff, and a modern Cooper-Bessemer motor-driven air compressor. Installed in Boeing's Research Laboratory almost a year ago, this big compressor supplied air under pressure for testing many of the B-47 parts, will go on year after year contributing to Boeing's broad development program.

The latest Cooper-Bessemer compressor developments offer new advantages, new economies to plants everywhere . . . wherever air is a tool. For example, modern opposed-action design means greater space-saving compactness, vibration-free operation, higher efficiency, and longer life with less maintenance.

So when it comes to air or power, it will pay you to write for the latest Cooper-Bessemer bulletins. Find out about the *new* things being done by one of America's *oldest* builders of engines and compressors.

The Cooper-Bessemer Corporation

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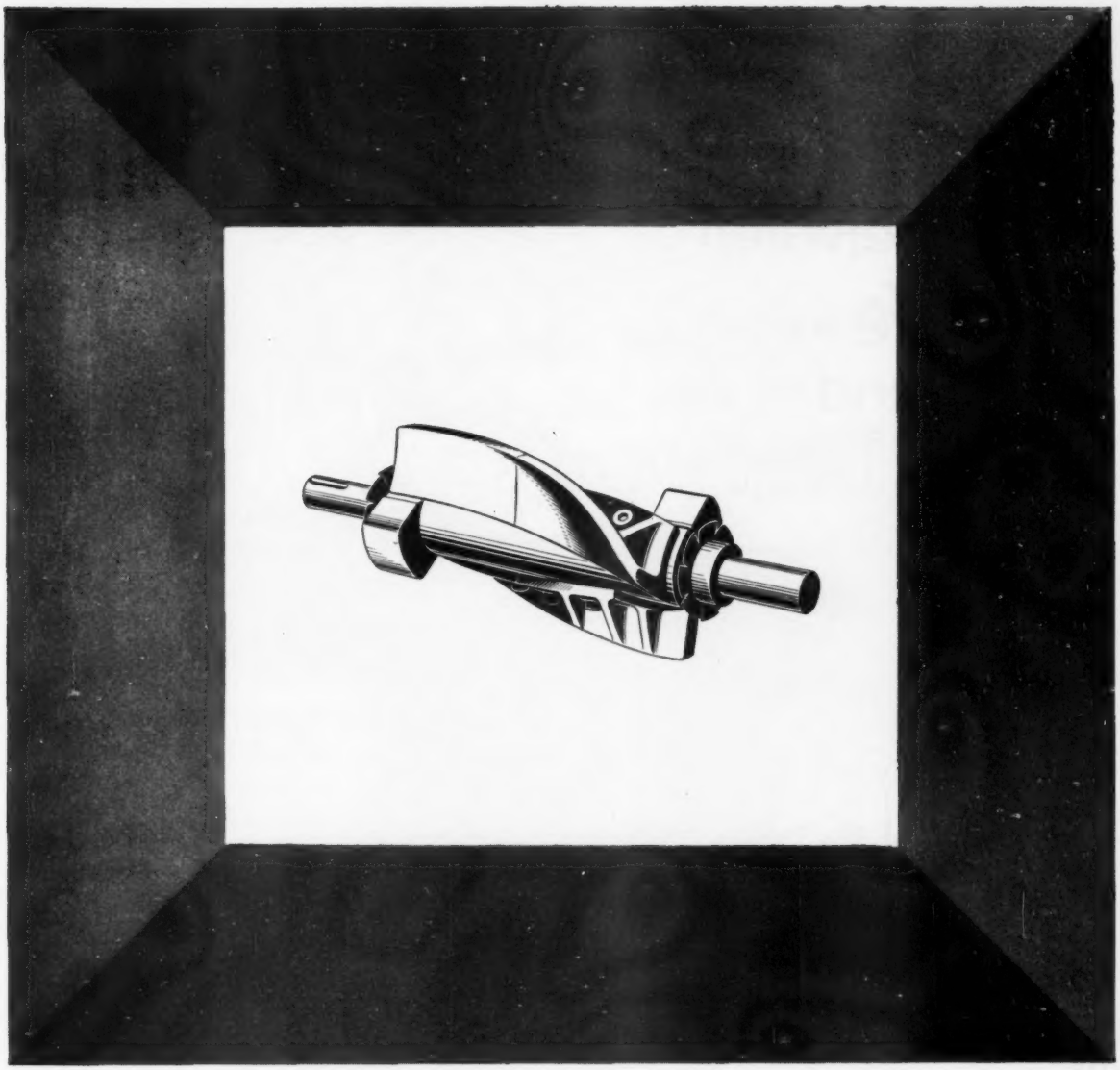
DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS • HIGH PRESSURE LIQUID PUMPS



How to make a stoker with Perfect Spread

WHETHER YOU PLAN to buy a new unit or to re-stoker an old one, it must be engineered to assure top efficiency with both low and high ash coals. And a prime requisite for such efficiency is *even* coal distribution over the entire grate . . . the perfect spread that is provided only by American Engineering's unique spiral overthrow rotor.

Supplementing that, you need the exclusive Perfect Spread traveling conveyor feeder that *won't clog . . . not even on wet coal.* This feeder operates on a high traction principle that provides true, *continuous* feeding throughout its whole range of 50 to 7500 lbs. of coal per hour. And for maximum combustion . . . most steam per fuel dollar . . . the special AE cinder return and adjustable overfire air system are unsurpassed.

Perfect Spread Stokers are available in a wide choice of sizes, capacities and grate types. Ask to have an American Engineering Company representative call and discuss your exact requirements.

AE

AMERICAN ENGINEERING

COMPANY

2400 ARAMINGO AVE., PHILADELPHIA 25, PA.

IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

The difference between Life... and Death...

"Why should you give blood? Ask me—I ought to know. I fought in Korea. But since then I've been through the biggest battle of all—the battle for life itself. And it was blood—and blood alone—that saved me. Don't know when I'll be in a position to start repaying my debt by giving some blood of my own. But I will—some day. You can count on it!"

All kinds of people give blood—for all kinds of reasons. But every reason for giving blood is a *special* reason . . . just as every American life that can be saved at any time and at any place . . . is special. So whatever *your* reason for giving blood, this you can be sure of: Whether it goes to a combat area, a local hospital, or for Civil Defense needs—this priceless, painless gift will some day save an American life!

Give Blood Now

CALL YOUR RED CROSS TODAY!

NATIONAL BLOOD PROGRAM

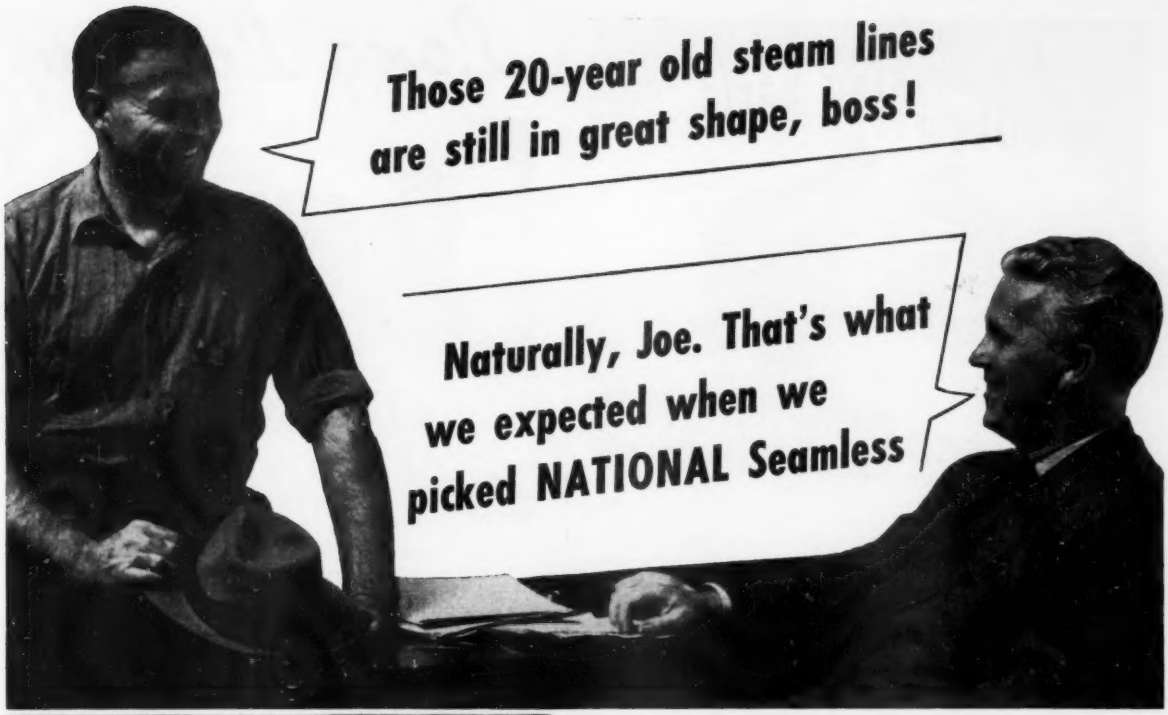
Business Executives!

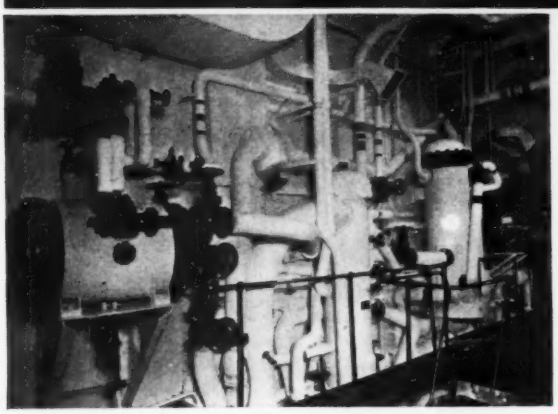
✓Check These Questions!

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ☐ Have you given your employees time off to make blood donations?
- ☐ Has your company given any recognition to donors?
- ☐ Do you have a Blood Donor Honor Roll in your company?
- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Have you conducted a Donor Pledge Campaign in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*


Those 20-year old steam lines are still in great shape, boss!
Naturally, Joe. That's what we expected when we picked NATIONAL Seamless



THE inspector's report is typical. For long, trouble-free service is the rule—not the exception—whenever National Seamless has been installed.

Recognizing this fact, and because high-pressure steam lines are the life lines of the modern steam plant, engineers everywhere are playing safe with National Seamless, the pipe that's pierced from solid billets of finest quality steel.

Every length of National Seamless Power Plant Piping is an homogeneous, soundly formed steel cylinder. There is no weld . . . no line of potential weakness to jeopardize the dependability of your lines.

Whether you are building a new plant, or just repiping present installations, National Seamless will give you longer, safer, more economical service.

Here's why **NATIONAL SEAMLESS** *is the preferred power plant piping.*

STRENGTH. Ultimate strength to meet any present specification requirements or more as required.

DUCTILITY. Meets requirements for flanging, bending, expanding, coiling, and similar purposes.

CREEP STRENGTH. Available in many grades of steel to assure maximum creep strength for the operating temperatures encountered.

CORROSION RESISTANCE. Various grades of steel from plain carbon to U·S·S Stainless according to service requirements.

HEAT RESISTANCE. Various heat-resisting alloys for higher temperatures and special conditions.

WELDABILITY. Readily weldable with the proper types of welding rods.

UNIFORM WALL STRENGTH. The seamless process stands alone among all processes of pipe making as the one method that removes all uncertainty regarding uniform wall strength.

Write for Bulletin No. 26, "Pipe and Tubes for Elevated Temperature Service," to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL *Seamless* POWER PLANT PIPING

UNITED STATES STEEL

Only ADSCO's exclusive features make maintenance so easy. There's no breaking of pipe connections to inspect or service the trap, because all working parts are mounted on the cover. An extra cover assembly becomes a complete spare trap . . . replace the cover in a matter of minutes, service the original, and the result is a spare trap always ready.

ADSCO traps offer additional exclusive advantages: reversible stainless steel valve and seat double the life of the trap . . . inlet and outlet connections on *both* sides make installation easy and less expensive. Write today for catalog data.

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

"GUNITING" with *Super* ADACHROME-CAST

Tradename "Gunlting" courtesy Cement Gun Co., Allentown, Pa.

...SAVES OUTAGE TIME and MONEY

Use SUPER ADACHROME-CAST to gunite your stud tube water walls,—Fine-grained to penetrate the small apertures between studs,—packs to a dense mass when shot. One user reports SUPER ADACHROME-CAST lasted twice as long and took but one-third the time to apply as compared with a plastic chrome ore installation.

Excellent for coating brickwork when free of slag.

Yours, FREE for the asking . . . an illustrated, detailed Bulletin on Super ADACHROME-CAST.

BOTFIELD REFRACTORIES CO.

784 S. Swanson St., Philadelphia 47, Pa.
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Long Lasting

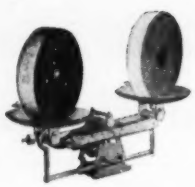
ALL PURPOSE NO. 535 SEA-RO Pump Valves

Sea-Ro No. 535 Pump Valves are custom made from a dense, fine grained phenolic base composition. This valve stock is treated with a binder, preservative, and impregnated with graphite, then laminated under pressure of 2000 lbs. per square inch. They are an all-purpose valve, eliminating the necessity for maintenance of various types of valves to insure economical operation. Sea-Ro No. 535 Valves are impervious to decomposition, warping and chemical action and can be resurfaced after years of service for extra duty under the toughest conditions.

Make these 3 Tests to be convinced

FOR SWELLING

Take one of your present pump valves and a Sea-Ro No. 535 of the same size. Boil them together in water for 24 hours. Then let the micrometer tell you its amazing story of Sea-Ro's resistance to swelling.



FOR ABSORPTION

Weigh both valves before boiling and then after. Let the scales reveal, as no words can, how Sea-Ro's laminated phenolic base resists absorption.

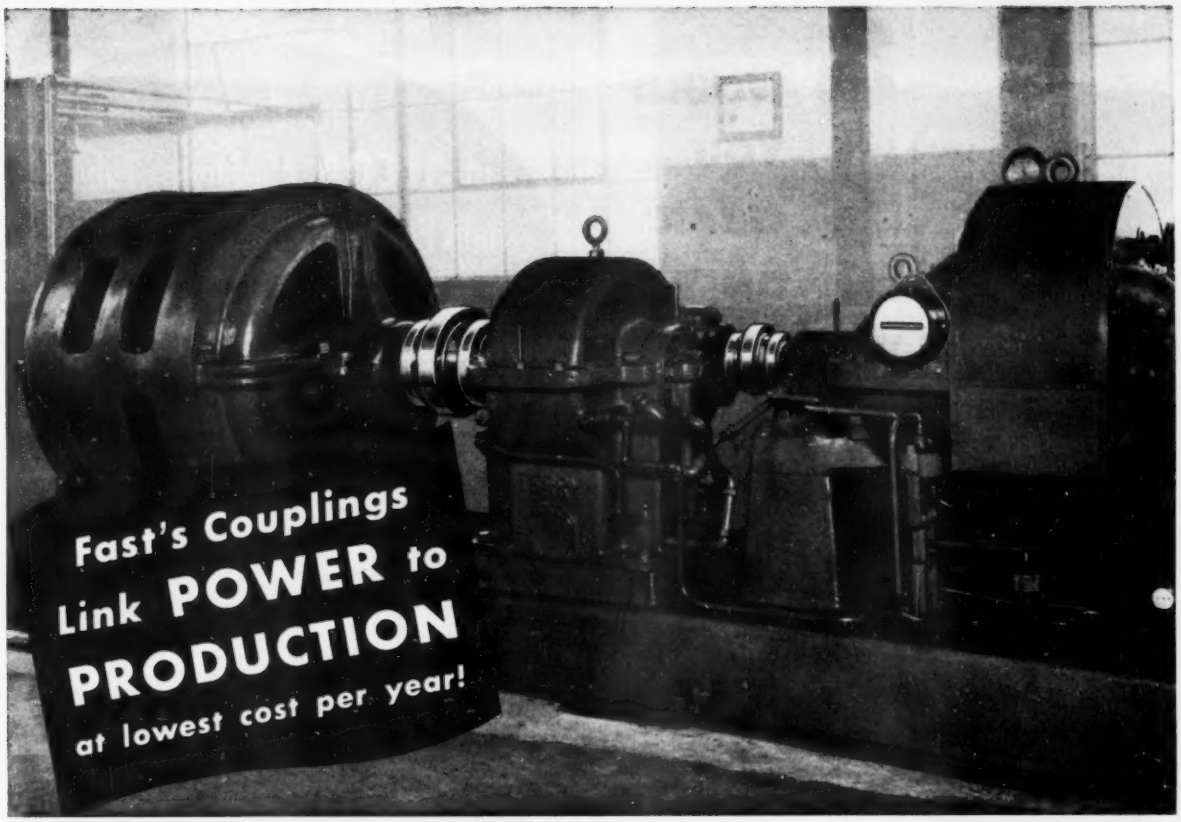
FOR SURFACING

Spot both valves on a face plate. You will immediately notice the velvet-smooth surface of No. 535 machine-ground into the dense, fine-grained Sea-Ro Valve.

FREE SAMPLE: We invite you to make these revealing tests on your pump installations. Send for a sample Sea-Ro No. 535 Valve without cost or obligation.

SEA-RO INDUSTRIAL AND MARINE PUMP VALVES

SEA-RO PACKING CO., INC., WOOD-RIDGE, N. J.



Every major producer of high-speed equipment uses FAST'S Couplings!

HIGH-SPEED equipment demands components with superior strength, accurate manufacture, long-lasting dependability. That's why it's important to *you* that Fast's Couplings are selected by every major high-speed equipment producer!

Fast's usually outlast the equipment they connect. Many have been in continuous operation for over 30 years, without trouble of any kind. And Fast's longer life saves you coupling dollars, too, because you amortize their cost over many years of trouble-free operation.

For full details on Fast's Couplings and Koppers Engineering Service, write today for your free copy of our catalog. Send to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 223 Scott St., Baltimore 3, Maryland.

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FAST'S
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS COMPANY, INC., ***Fast's Coupling Dept.***
223 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

Company .....

Address .....

City ..... *Zone* ..... *State* .....

WOULD YOU CLEAN ONLY

PART OF YOUR FACE?

No, of course, you wouldn't! Then why clean only *part* of the oil in your engine? Why be satisfied with anything less than the best protection you can give your engine's moving parts? Keep *all* your oil clean, and all the moving parts of your engine protected, with warranted Winslow Full-Flow Filters!

WINSLOW FILTERS

Winslow Engineering Company • 4069 Hollis St., Oakland 8, Calif.

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ALL MERCURY SWITCH EQUIPPED

CONTROLS

FOR EVERY APPLICATION

PRESSURE	LIQUID LEVEL	WEATHER-PROOF
TEMPERATURE	EXPLOSION-PROOF	RELAYS

If you have an automatic control problem involving the control of pressure, temperature, liquid level or mechanical movement, write for Catalog No. 700A. Relays, valves and mercury switches are also listed therein.

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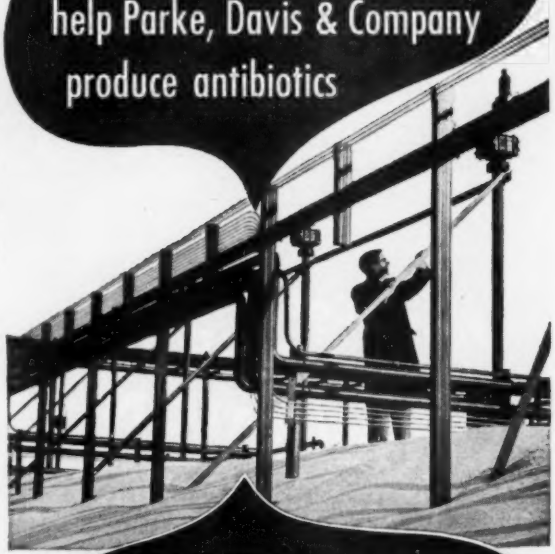
New York: 205 East 42nd St. ◆ Philadelphia: 3137 N. Broad St.

More than **4** miles of **ALCOA** Aluminum Tubing help Parke, Davis & Company produce antibiotics



ALCOA UTILITUBE—*more than four miles of it*—connects outdoor tanks with gages at Parke, Davis & Company's new Chloromycetin plant at Holland, Michigan—the world's only plant producing antibiotics by chemical synthesis. Alcoa's all-purpose aluminum coiled tube is used for instrument line service at this 124,000-gallon tank farm.

Alcoa Utilitube offers savings up to 40% over copper . . . has excellent on-the-job forming and flaring properties. It is available in economical, long lengths up to 1,000 feet or more, depending on size. It stands up well under vibration . . . has high resistance to most industrial atmospheres and to many liquids and gases.

In petroleum service, Alcoa Utilitube will not form sludge or gum . . . will not discolor or contaminate the fluid it carries.

Use Alcoa Utilitube for:

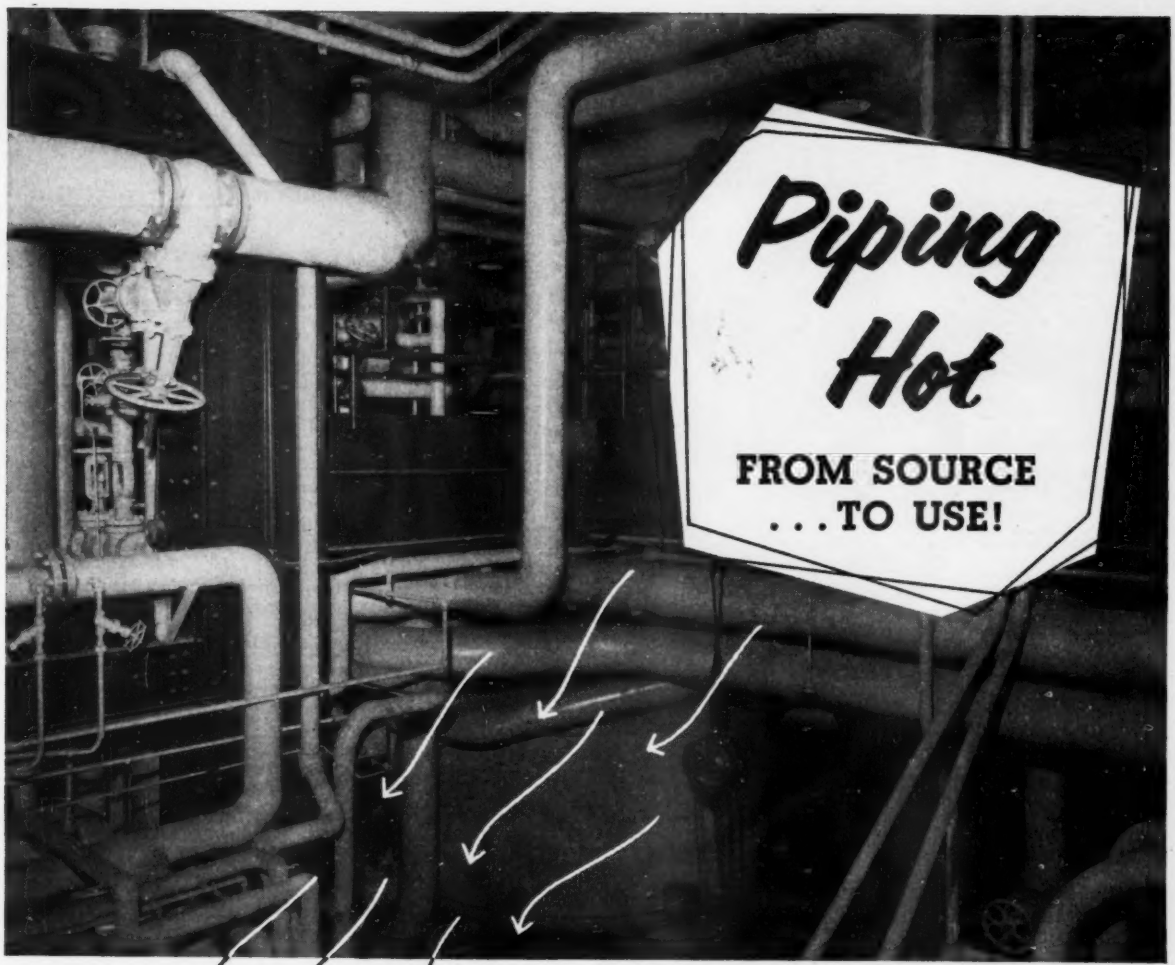
- Air for pneumatic and hydraulic control circuits and brake lines.
- Gasoline and fuel oil for internal combustion engines.
- Lubricating oils for engines and machines.
- Fluids for hydraulic systems.

For complete details, write for the new booklet: *Alcoa Utilitube.*

ALUMINUM COMPANY OF AMERICA
1004-c Alcoa Building, Pittsburgh 19, Pa.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

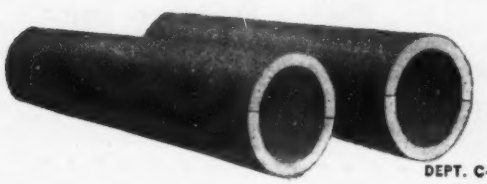


UNARCO

Unibestos®

PIPE INSULATION

for Temperatures up to 1200°F



High thermal efficiency! That's one of the features of Unibestos Pipe Insulation. It's an outstanding b.t.u. barrier.

Yes, and it's easy to fit—cuts quickly, cleanly. And Unibestos lasts and lasts because it's highly resistant to moisture, fumes, vibration, and impact.

That's why you're finding more Unibestos in more plants every day. It's made in cylinders and half-rounds in two types: No. 750 for temperatures up to 750°F.; No. 1200 for up to 1200°F. And it's also available in block-form for up to 1200°F. uses.

Phone your nearby Unarco Distributor for recommendations and prompt service on Unibestos, Amocel, and other dependable Unarco insulations. For new installations or replacements, there's nothing better.

UNION ASBESTOS & RUBBER CO.

DEPT. C-3, 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILL.

HOW TO GET BETTER PUMP PERFORMANCE

Worn, leaky pump valves are the cause of frequent repairs. Replace them with Sims Pump Valves — you'll get guaranteed better performance.

These four features combine to give you longer service with Sims valves:

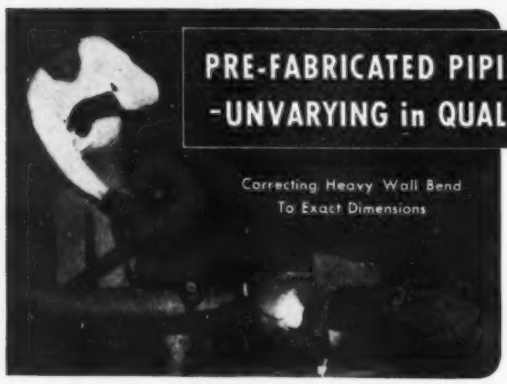
1. Exclusive double shock-absorber stem heads eliminate stem breakage.
2. Long guide gives even lift — reduces wear. Spring is protected against jamming.
3. Rotating valve disc changes to new seating-surface every time it opens — doesn't hammer up and down on same spot.
4. Inclined ribs reduce turbulence. Low resistance prevents vapor binding — allows increased speed that gives you greater pump capacity.

WRITE FOR NEW CATALOG

Write for new catalog showing how Sims valves fit your pump and give better pump performance.

SIMS PUMP VALVE CO., INC.

1314 PARK AVE., HOBOKEN, N.J. • M & M BLDG., HOUSTON, TEXAS



PRE-FABRICATED PIPING -UNVARYING in QUALITY

Correcting Heavy Wall Bend To Exact Dimensions

● At Western Piping Supply, the men who weld, align, heat treat and test all have special qualifications for their particular tasks. Most, also, have many years of service with the company.

This combination of skill and experience spells out uniform quality in every job, from job to job, year in, year out. It's a good reason why WPS enjoys an exceptionally high customer repeat rate, and good reason, too, why you should specify WPS when you want superior quality piping.

WESTERN PIPING SUPPLY DIVISION
THE LUMMUS COMPANY
504 WEST 145TH STREET, EAST CHICAGO, INDIANA
Representatives in Major Cities
FABRICATORS OF CARBON AND ALLOY PIPING

6 Essential Facts

for a company with a Water Problem...

1. Costs Far Less to Install!
A Ranney Water Collector will add millions of gallons to your daily water supply—at a fraction of the cost of conventional systems!

2. Less Expensive to Operate!
A Ranney Water Collector is far less expensive to operate —uses fewer pumps, fewer personnel, less power, and usually requires no treatment facilities.

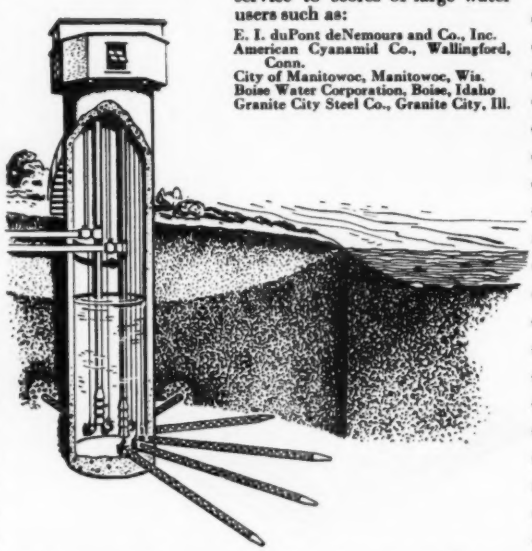
3. Maintenance Requirements Practically Nil!
A Ranney Water Collector requires little or no maintenance. The rate of flow through the Ranney Collector's apertures eliminates clogging and silting. No filter plant maintenance.

4. More Water per Unit!
A single Ranney Water Collector has produced more clear, cool water than ten conventional vertical wells.

5. Far Longer Life Cuts Depreciation Costs!
The longer life of a Ranney Water Collector lowers financing and depreciation rates appreciably.

6. Ask These Satisfied Users
Ranney Water Collectors are currently rendering excellent service to scores of large water users such as:

E. I. duPont deNemours and Co., Inc.
American Cyanamid Co., Wallingford, Conn.
City of Manitowoc, Manitowoc, Wis.
Boise Water Corporation, Boise, Idaho
Granite City Steel Co., Granite City, Ill.



An inexpensive Ranney survey will determine how the Ranney Method can work for you.

If you need water, write us for complete information on how a Ranney Water Collector will solve your problem.

Ranney Method Water Supplies, Inc.

HYDROLOGISTS AND WATER SUPPLY CONTRACTORS

Executive and Engineering Offices
Dept. E3, P.O. Box 277, Columbus 9, Ohio

A gauge for every need... *each the best of its kind*

Three basic groups of Marsh Gauges are shown here:

- The "Standard" group for the general run of gauge services.
- The "Quality" group for tougher service conditions.
- The "Mastergauge" group for the most extreme conditions.

While there is a considerable difference in the design and construction through these groups, the choice of a Marsh Gauge for a given application depends squarely upon the *service condition.*

This is because all Marsh Gauges — from lowest price to highest price — are high quality gauges. Each group or series contains the *best gauges of their kind.*

That is why you should use Marsh Gauges. Select the right Marsh Gauge and you use the most *economical* gauge for your requirement. We will help you select it.

Write for Catalog

Marsh Instrument Co., Dept. F, Skokie, Ill.

Sales affiliate of Jas. P. Marsh Corporation

Gauges • Thermometers • Water Regulating Valves • Solenoid Valves
Heating Specialties

MARSH GAUGES

THE STANDARD OF ACCURACY

— Just some of the reasons why so many users prefer

AMESTEAM GENERATOR

20 SIZES
10 to 600 h.p.
15 to 200# OIL OR GAS

— and here are some others:

★ Eye-level controls — protected from dirt, water and accidental damage

★ AMES SERVICE — our **LOCAL** service man starts your unit and provides 3 months' FREE SERVICE

WRITE FOR THIS FREE BULLETIN ON CUTTING STEAM COSTS!

NAME.....

COMPANY.....

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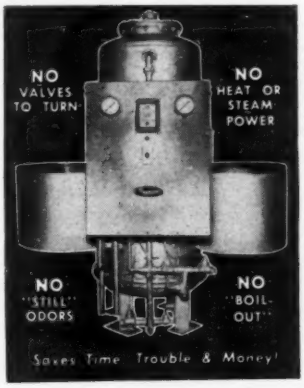
AMES IRON WORKS INC.

BOX I-33 OSWEGO, N. Y.

Builders of Better Boilers since 1848

HIGH PURITY WATER

For Boiler Feed, Process & Other Needs



The new Penfield Mono-Column Demineralizer pictured above performs all its operating functions automatically — even accomplishes complete regeneration, including automatically recutting in effluent, with one turn of a switch. Write for full information on units of any desired capacity from 10 to 10,000 gph.

COMPLETELY AUTOMATICALLY

Employing the most effective deionizing technique known (intimately mixed cation and anion exchangers in a single tank), raw water passes through a Penfield Automatic Mono-Column Demineralizer only once — *yet comes out with resistances reported as high as 20,000,000 ohms.* Better mineral-free purity than is practical by distillation is supplied for *only pennies per each 1,000 gallons.* And everything is accomplished completely automatically—*without muss or fuss.*

No "Extras"! No "On-The-Job" Assembly Problems!

Penfield Demineralizers are shipped ready-to-operate. Standard equipment includes MONEL METAL regeneration tanks and all necessary gauges, flow meter, conductivity meter, etc. Simply connect the completely "packaged" unit to service lines and start operation.

PENFIELD MANUFACTURING CO., INC.

19 High School Ave., Meriden, Conn.

FILTERS · SOFTENERS · DEGASIFIERS · DEMINERALIZERS

Penfield "Planned Purity" PAYS!

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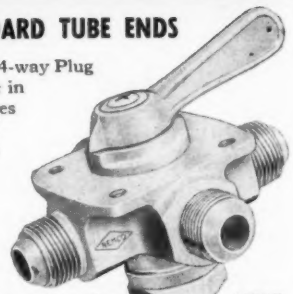
INDUSTRIAL · CHEMICAL · AIRCRAFT

J. I. C. AND AN STANDARD TUBE ENDS

Skilfully engineered 2, 3, and 4-way Plug Valves are built by Republic in brass and aluminum alloy, sizes ⅛" to 1". Hydraulic Relief Valves opening at pressures up to 450 psi made in brass, aluminum alloy, steel, and stainless steel, sizes ⅛" to ¾". Pipe, AN or J.I.C. tube ends, or combinations.



4-WAY PLUG VALVE, WITH DRAIN

Also manufacturers of high quality globe, needle, low and hy-pressure check valves, and special valves to specifications.

Write for complete catalog and name of nearest distributor.

83

REPUBLIC MANUFACTURING CO.

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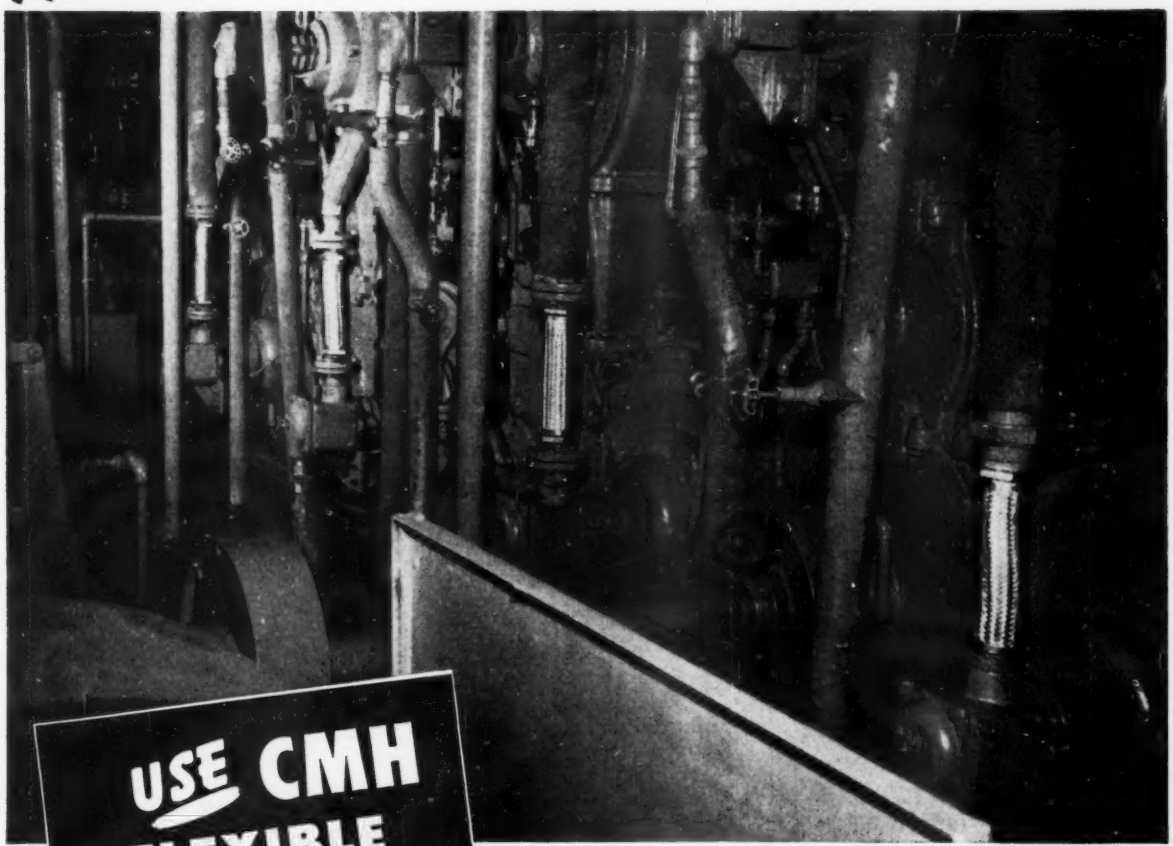
WHEREVER rigid piping must be connected to machinery



USE CMH FLEXIBLE METAL HOSE

YOUR GUIDE TO MOTION CONTROL

Catalog 130 gives specifications for all types of CMH hose. Write for a copy or see the Flexonics catalogs in Chemical Engineering Catalog and Sweets Plant Engineering File.

By using CMH Flexible Metal Hose as the connecting link between rigid pipe and machinery, you solve two otherwise serious problems—the elimination of damage to the piping because of vibration and the compensation for any misalignment that may exist. Properly installed, CMH Flexible Metal Hose will give long, dependable, trouble-free service without further attention.

Whatever your flexible connection problem, there is a CMH hose type to meet your needs. Corrugated and convoluted types are available in a wide variety of designs and in a complete range of sizes. CMH Flexible Metal Hose is offered in steel, bronze, stainless steel and other alloys to fill your requirements. Your Flexonics distributor will give you further data. Look for his name in your classified telephone directory or we will be pleased to send it to you.

Flexon identifies CMH products that have served industry for over 50 years.

CMH

CHICAGO METAL HOSE Division

Flexonics Corporation 1301 South Third Avenue, Maywood, Illinois

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Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows

HILL PUMP VALVES
Since 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Write for Bulletin
HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

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Featuring additional products specialties and services for power plants

GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR WATER GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

STOP *that* WATER
With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.
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Consulting Engineers
POWER PLANTS
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put the solution of your problems up to a specialized Consultant whose professional card appears on this page. His broad experience may save you months of costly experimentation.
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Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
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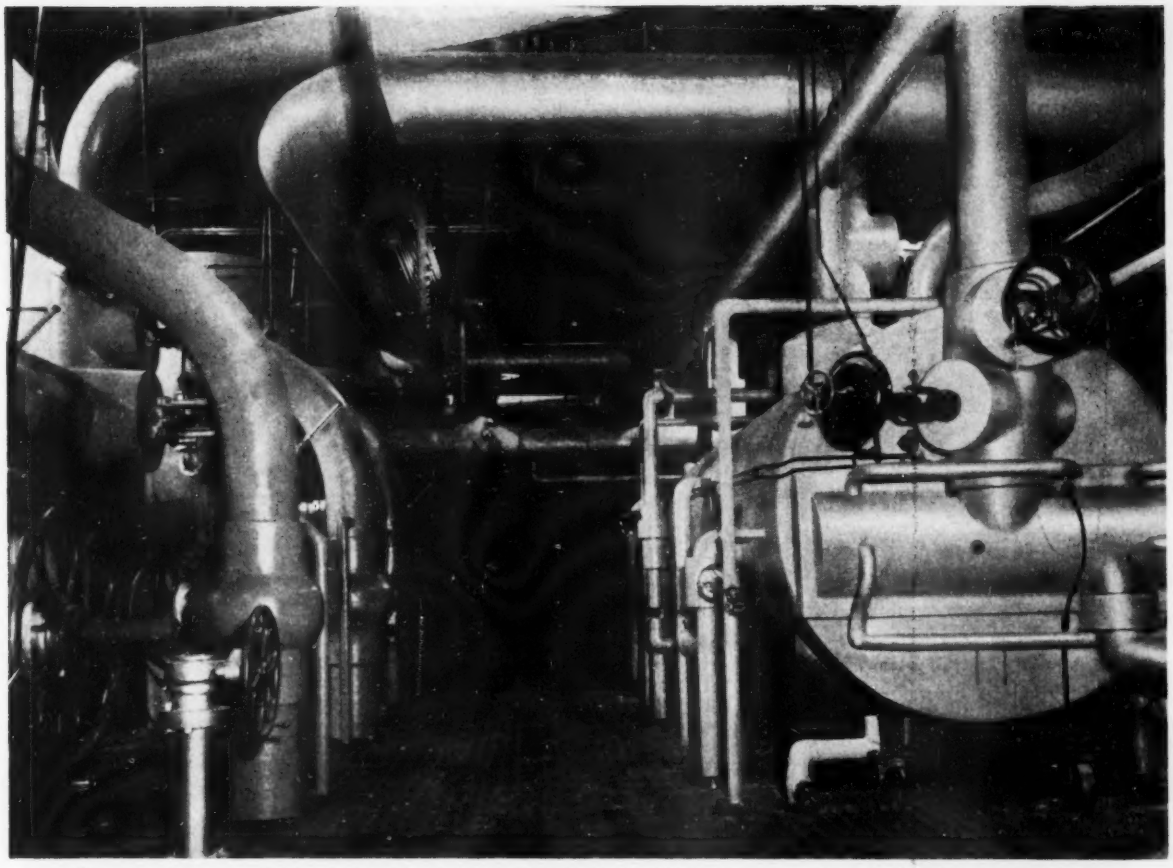

Scene in large southern power station. Main steam line and feeder equipment insulated with K&M Hy-Temp and "Featherweight" 85% Magnesia, in combination

Save heat-Save dollars

with K&M high-temperature insulations

For applications up to 1900°F., the combination to keep in mind is that of K&M Hy-Temp Insulation and "Featherweight" 85% Magnesia.

Two separate layers of insulation with vertical and horizontal staggered joints eliminate heat loss which occurs when expansion of hot piping and equipment causes joints to open in single layer installations. K&M Hy-Temp Insulation (diatomaceous silica), effective up to 1900°F. is applied directly to the hot surfaces and "Featherweight" 85% Magnesia Insulation (85% basic carbonate of Magnesia and asbestos fiber), effective up to 600°F. forms the second layer.

This effective K&M combination will last the life of the equipment it serves —will withstand moisture, vibration, alternate heating and cooling, wetting and drying. Both materials are supplied in all appropriate forms and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

Nature made Asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

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COMPANY • AMBLER • PENNSYLVANIA

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Save time...

ENGRAVE your own NAMEPLATES

DIALS • PANELS

The fastest, easiest method for engraving individual nameplates, dials and panels.

- Automatic depth regulator.
- Engraves 15 sizes from One master alphabet.
- Equipped with self-centering device.

Send for Catalog IM 58

NEW HERMES, Inc. 13-19 University Place, N.Y. 3
In Canada: 359 St. James St., Montreal
World's Largest Manufacturer of Portable Engraving Machines

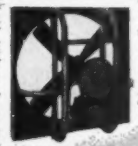
NEW! HEAVY DUTY CHELSEA FANS – for every industrial application!

POWER LINE FANS

• TYPE PLF POWER LINE DIRECT DRIVE — 16" to 48", all H.P. ratings. Square frames for easy mounting.

• TYPE PLDX POWER LINE DUCT BOOSTER — Motor external to air stream. 16" to 48", all H.P. ratings.

• TYPE PLDU POWER LINE AIR BLASTER — For spot cooling — available on pedestal. 18" to 42", all H.P. ratings.



• TYPE PLBD POWER LINE BELT DRIVEN — 24" to 48", all H.P. Square frames for easy mounting.

— solve your ventilation problems

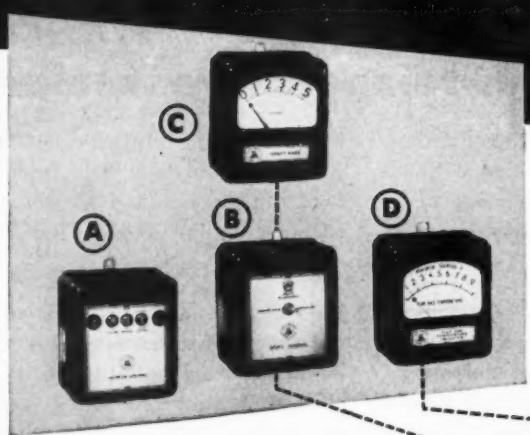
with CHELSEA'S new heavy duty airfoil type exhaust fans. For use in exhausting, duct work, filter installations, range or vat hoods, penthouse units, paint spray booths, where static pressure is encountered. All ratings are certified by P.F.M.A. test methods to insure proper performance.

Write for Catalog No. 400 address Dept. S-3

CHELSEA FAN & BLOWER CO., Inc.
PLAINFIELD, NEW JERSEY

PERFEX DRAFT CONTROL SYSTEMS pay for themselves fast

Save Fuel
Save Labor
Save Money



Ⓐ PROGRAM CONTROL

Opens damper before burner starts, and guides draft control for all firing rates and during "OFF" periods. Built-in fused line-switch; burner "on-off" switch; Damper "Automatic-Closed" switch.

Ⓑ DRAFT CONTROL

Measures draft condition in fire box. Causes Actuator to reposition uptake damper. Includes built-in damper "Open Automatic" manual switch.

Ⓒ DRAFT GAGE

Provides continuous visual check of draft conditions. Simplifies adjustment of Draft Control.

Ⓓ FLUE GAS TEMPERATURE INDICATOR

Reflects extent to which boiler has absorbed heat. Warns of wasteful conditions, such as failing baffler, fouled tubes, excessive draft, improper fuel and air ratio adjustments.

ACTUATOR

The Actuator positions the uptake damper in response to the commands of the control system to maintain the correct overfire draft condition.

PERFEX INDUSTRIAL INSTRUMENTS

Perfex Corporation, Milwaukee, Wis. • In Canada, Perfex Controls Ltd. Guelph, Toronto

ELECTRICAL AND POWER ENGINEER

Also Mechanical, Civil, Industrial and Chemical Engineers and Machine Designer — Needed for expanding Engineering and Development program. Openings for various types of experience and levels of responsibility. Please reply in writing with a full resumé of training and experience, including salary requirements. All applications handled promptly and confidentially.

Personnel Department
Congoleum-Nairn Inc.
Kearny, New Jersey

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

ASSISTANT CHIEF Engineer. Wisconsin paper manufacturer has an opening for an individual to assist our Chief Engineer in charge of paper mill-power plant, supervising the operation and maintenance of high pressure boilers, turbines and auxiliary equipment. As this is a key position in our engineering staff, and because our engineers are expected to operate on a reasonably independent level it is essential that the man we are looking for have a sound and complete knowledge of the technical and practical aspects of power in order to be considered for this position. The salary is open. In addition we have what we believe to be an excellent profit-sharing retirement plan and, of course, the company pays for the complete cost of group hospital and surreply will be held in strictest confidence. Write gical insurance as well as life insurance. Your P-6361, Power.

ASSISTANT FOR Chief Mechanical Engineer. Toledo Ohio mechanical contractor has an opening for an individual having experience in design and execution of heavy industrial piping systems. Good draftsman preferred though the opportunity is open to get away from the board. Not a one project job. P-6724, Power.

COMBUSTION ENGINEER—Graduate Engineer with about ten years experience on stokers and combustion controls, to maintain top boiler performance on fleet of Great Lakes vessels. Work on vessels and in office ashore. State qualifications and salary required. P-6883, Power.

ELECTRICAL ENGINEER: Wisconsin paper manufacturer has an opening for an electrical engineer with some experience in maintenance and layout. The man we are looking for will have a sound grasp of the technical aspects of electrical engineering as well as a year or more experience in an industrial situation. He should be familiar with plant electrical requirements, power and control equipment and wiring, both A.C. and D.C. Salary based on individual ability with excellent opportunity for financial advancement. In addition, we have a profit-sharing retirement program and the company assumes the cost of complete group insurance coverage. Your replies will be held in confidence. Write P-6362, Power.

PIPING ENGINEER—Salary Open. Fast growing Construction Company wants Piping Engineer capable of making detailed material take offs on Powerhouse, Chemical, Paper Mill and Oil Piping, and handling buying of same. Location central Southeast, most work lump sum. In experience record clearly separate engineering from actual construction experience, give salary and direct supervisor each previous job, as well as at least 4 references familiar with your work. Will pay whatever salary ability justifies. P-6682, Power.

WANTED: GRADUATE Engineers, preferably chemical, for both Consulting and Field Sales work. For Sales, should have 3 or more years successful record. For consulting, young men preferred so that our business can be taught to them and they can move up in years to come. Write to D. Saunders, Permutit Co., 7th fl., 330 W. 42nd St., N. Y.

EMPLOYMENT SERVICE

SALARIED PERSONNEL. $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

(Continued on page 302)

SEARCHLIGHT SECTION

Classified Advertising

EMPLOYMENT: BUSINESS: **"OPPORTUNITIES"** EQUIPMENT: USED OR RESALE

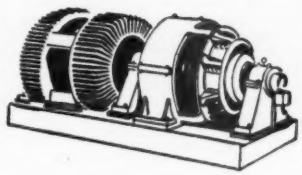
UNDISPLAYED —RATES— DISPLAYED

$1.50 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted & Individual Selling Opportunity undisplayed advertising rate is one-half of above rate, payable in advance.
Box Numbers—count as one additional line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Individual Spaces with border rules for prominent display of advertisements.
The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

New Ads: Address 330 W. 42nd St., New York 36, N. Y. for April issue closing March 6th.

SEARCHLIGHT EQUIPMENT SPOTTING SERVICE



This service is aimed at helping you, the reader of POWER, locate used and surplus new power equipment not currently advertised.

Just send in the specifications of the equipment wanted on the coupon below, or on your own company letterhead, to

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

NO CHARGE • NO OBLIGATION

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., New York 36, N. Y.

Please help us locate the following used equipment:

.....

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NAME ..... TITLE .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

3/53

Additional Employment Advertising on Page 302

Engineers

wanted by

STANDARD OIL COMPANY (*Indiana*)

Mechanical, civil, and chemical engineers are needed for design and inspection work at Standard Oil Company's largest refinery located near Chicago.

Continuing expansion of facilities and technological advances create openings for qualified engineers. Recent graduates are desired, and are offered an opportunity to work and advance with one of the leading companies in an industry noted for its engineering achievements.

Engineering staff is permanent, with excellent opportunities for advancement and also promotional outlets to other departments of the Company. Positions are well-paying and outstanding employee benefit plans are provided.

The interesting variety of work includes inspection of existing oil refining units and of new facilities; also the design, construction, development and servicing of all types of oil refinery equipment. This includes power plants and distribution systems, water supply and waste disposal facilities, structures, buildings, heat exchangers, piping, fractionating and other process equipment used in the development and distribution of petroleum products.

Reply by letter, giving complete summary of education and experience and stating salary expected. All applications will be carefully considered and kept strictly confidential.

STANDARD

ADDRESS: Mr. P. L. Krauel
Chief Engineer, Whiting Refinery
Standard Oil Company
2400 New York Avenue, Whiting, Indiana

(Continued from page 301)

POSITIONS WANTED

CONSTRUCTION ENGINEER—Experienced in high pressure powerhouse pipe erection, fabrication and instrument installation. Supervision on preheating and stress relieving of alloy pipe. PW-6839, Power.

DIESEL POWER Plant operator and Maintenance mechanic. Ten years experience marine and stationary operation and repair, including five years dual fuel. Will consider taking charge of small plant. 1st assistant unlimited horsepower marine license. 2nd class Minnesota stream 100 H.P. Age 44 years. PW-5209, Power.

ELECTRICAL ENGINEER, with E. E. degree, Dec. 1948. With 25 years practical experience. Building, Maintaining, installing and wiring of electrical machinery. 10 years experience (Practical) with steam. Have references from such concerns as the G.E., Westinghouse and others. Desires a position looking after the maintenance and future expansion of some good plant or factory. Write H. Waterstone, 137 Court St., Charleston, W. Va.

POWER SUPT: Thoroughly qualified to represent Industrial Concern during planning and construction of modern steam power plant, with view to organizing and directing Power Division in operations. PW-6701, Power.

POWER & Maintenance Supervisor-Twentyseven years of sound technical and practical experience in modern power plants. Water-treatment, high pressure boilers, condensing and non-condensing turbo generators. Married man with best of references. PW-6875, Power.

STOCK LIST

1953 Partial Stock List of new & rebuilt power equipment available free of charge. Write: Electric Equipment Co., 63 Curlew St., Rochester, New York.

EFFECTIVE REPRESENTATION

If you manufacture a complete line of horizontal and vertical pumps for all industries (particularly Chemicals and Paper Stock) and want effective representation by sales organization with pump know-how, and excellent contacts in Metropolitan New York-New Jersey Area, we can do a job for you.

RA-6864, POWER
330 W. 42nd St., New York 36, N. Y.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

LEFAX POCKET SIZE TECHNICAL DATA BOOKS, $1 EACH

Printed on loose leaf, six hole, 6¾" x 3¾" bond paper each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and business man.

Architecture	Metals	Transformers,
Home Heating	Gen'l Chemistry	Relays, Meters
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Electrician's Data	Building Constr.	Mech. Drawing
Builder's Data	Radio	Machine Design
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Air Conditioning	Electricity, AC	Piping Data
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Write for FREE Catalogs (over 2000 listings). See for yourself how helpful LEFAX can be to you. Send $1 for each book, or $5 for any six books listed.

LEFAX DEPT. PO 15, PHILADELPHIA 7, PA.

WANTED

700 H.P. (approx) diesel engine only 750 RPM.
250 H.P. 440/3/60/720 RPM Slip Ring motor.
800 H.P. 600 Volt DC motor.

SOUL CLINIC, INC.
CALGARY, CANADA

OPPORTUNITIES FOR ELECTRICAL ENGINEERS WITH GOODYEAR ATOMIC CORPORATION

Electrical Engineers with BS or MS degrees, or the equivalent in training and experience, required to staff the Engineering Division of the Billion Dollar Atomic Plant now under construction near Portsmouth, Ohio. Fields of opportunities include:

- **Design, Construction, Operation and Maintenance of High Voltage Transmission and Distribution Systems. Operating and dispatching experience on 154 KV systems highly desired.**
- **Design, Development and Maintenance of Electronic Control Systems.**

Reply by letter stating education, work experience and salary required.

Industrial Relations Division

GOODYEAR ATOMIC CORPORATION
1144 E. Market St., Akron 16, Ohio

COAL SALESMAN

Elk River Coal & Lumber Co. and Michigan & Southern Coal Corp., operating mines and selling their own and other coals, want capable salesman with some technical background and power plant experience for Eastern Michigan and Northwestern Ohio. Salary and/or commission. Automobile furnished. **Reply P. O. Box 1679, Columbus, Ohio.**

CASH FOR SURPLUS
MOTORS
GENERATORS
TRANSFORMERS
COMPRESSORS
WORLD'S LARGEST INVENTORY

See our other ad on page 310

ELECTRIC EQUIPMENT CO.
ROCHESTER, N. Y.

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES

No lengths too long or too short
TELEPHONE: EASTGATE 7-4778

PIERCE CABLE CO.
2668 CLYBOURN AVE., CHICAGO 14, ILLINOIS

WANTED
OISC TRANSFORMERS

3—1500 KVA, 44000—2400 or 480 volt, single phase, 60 cycle, OISC transformers. OR 3 phase equivalent.

ARTHUR G. PORTER
LUTSEN, MINNESOTA

WANTED FOR CASH

Electric Motors—Starters, Transformers—Oil & Air Brks. Wie—Cable—Wiing Mateials.
Send Listings

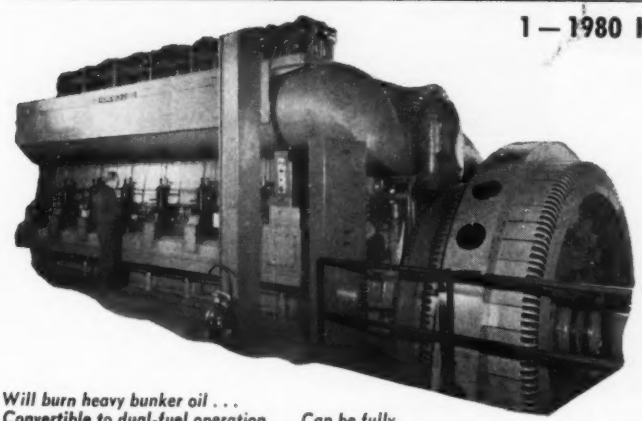
ALLIED ELECTRIC & MACHINERY CO.
1007 Falls Bldg., P. O. Box 1838
MEMPHIS 1, TENN.

CURRENT MODEL·· DIESELS

3480 KW DIESEL GENERATOR PLANT

Heavy Duty • Slow Speed • Available Immediately

1 — 1980 KW NORDBERG MODEL TS-217 DIESEL UNIT



Will burn heavy bunker oil . . .
Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE

ENGINE: 3000 HP (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21¾" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

(50 cycle rating 1650 KW at 187 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake, exhaust, water, lubricating oil, fuel oil, and air.

Generator and exciter control switchgear.

1—1500 KW FAIRBANKS MORSE MODEL 33E16 DIESEL UNIT

ENGINE: 2000 BHP Fairbanks Morse 10 cylinder, 2 cycle engine at 300 RPM, 16" bore, 20" stroke, cylinders arranged vertical in line, solid injection.

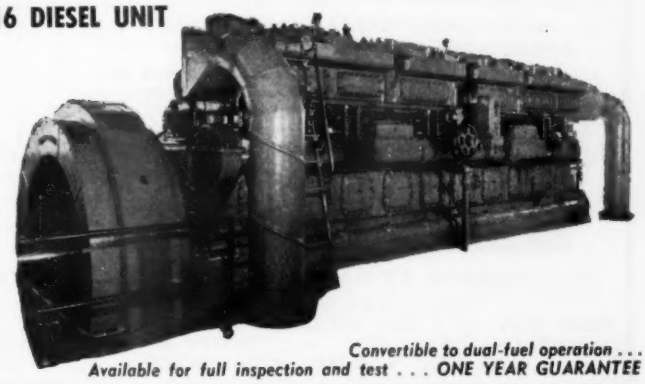
GENERATOR: 1500 KW, 1875 KVA Fairbanks Morse generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 300 RPM.

(50 cycle rating 1250 KW at 250 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust mufflers, lubricating oil cooler, Fairbanks Morse evaporative type cooler with automatic controls, fuel oil day tank with transfer pump and fuel oil meter, motor-driven air starting unit with air tanks, 2 lubricating oil storage tanks with transfer pump, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake, exhaust, water, lubricating oil, fuel oil, and air.

Generator and exciter control switchgear.



Convertible to dual-fuel operation . . .
Available for full inspection and test . . . ONE YEAR GUARANTEE

The two units above afford a rare opportunity to procure complete, modern, current model, heavy-duty, slow speed diesel sets at a great saving. They represent an offering which cannot be duplicated anywhere in the diesel market today.

Act now . . . Phone, Wire, or Write for Full Details

ALL OWNED AND OFFERED EXCLUSIVELY BY

TELEPHONE
DIGBY 9-4350

TELETYPE
NY 1-2804

A.G.

"America's Largest Source of New and Remanufactured Diesel Power"

SCHOONMAKER CO., INC.

Western Union — WUX —
A. G. Schoonmaker Co. Inc., N. Y.
CABLE:—AGSCOMACH

50 CHURCH ST., NEW YORK 7, N. Y.

Plants and Warehouses: Jersey City, N. J. and Sausalito (S.F.), California

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

America's largest source of New and Remanufactured Diesel Power

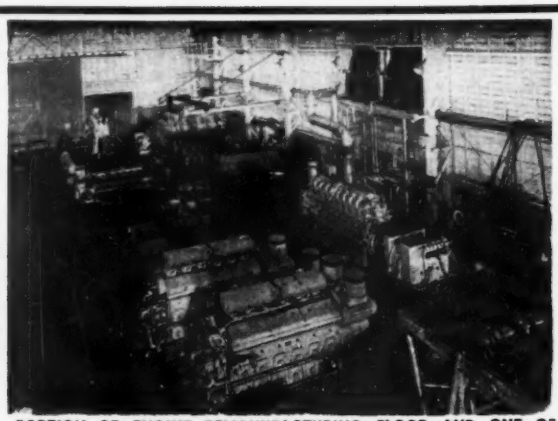
See our Ad on Page 303

A.G.

SCHOONMAKER CO., INC.

50 CHURCH ST., NEW YORK 7, N. Y.

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA
TELEPHONE — DIGBY 9-4350 • TELETYPE — NY 1-2804
W. U. WIRE • CABLE — AGSCOMACH



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1980	Nordberg	TS-217	3000	225
1500	Fairbanks Morse	33E16	2000	300
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	Baldwin	VO-8	750	514
500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
400	Ingersoll-Rand	S-8	600	720
350	Baldwin	VO-6	510	450
320	Enterprise	DSG-6	460	450
250	Fairbanks Morse	33-D	375	360
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS
1—20,000 KW, 200# 13,200 V.
1—10,000 KW 200# 13,800 V.
1— 5,000 KW 275# 11,500 V.
1— 4,000 KW 400# 2300 V.
1— 3,000 KW 425# 13,200 V. Ext. 170# Non Cond.
1— 3,000 KW 175# 550 V. Cd.
1— 1,500 KW 150# 2300 V. Cd.
1— 1,500 KW 175# 550 V. Ext.
1— 1,250 KW 250# 2400 V. Ext.
1—1,000 KW 200# 4160 V. N.C. NEW 1940.

2— 750 KW 150# 250 V. D.C.
1— 500 KW 200# 4160 V. N.C.
1— 300 KW 125# 250 V. D.C.
2— 120 KW 150# 240 V. N.C.

DIESEL GENERATORS
1—1000 KVA 2400 volts
3— 500 KW 480 volts
1— 400 KW 480 volts
1— 300 KW 2400 volts
2— 75 KW 240/480 V.

BOILERS
2—50,000# 275# (1949)
3—15,000# 275# (1945)
1—300 H.P. 250# (1938)
2—250 H.P. 200# (1940)
1—84" HRT 150# (1942)

CRANE
1—16 Ton Span 30'-10½" Hand operated

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.
THE BUYERS MUST BE SATISFIED—ALWAYS

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

2—75 KW. GENERAL ELECTRIC 3 WIRE M.G. SETS

GENERATOR: 75 KW, type CD 1242, 250/125 volts, 1200 RPM, Compound Wound.
MOTOR: 125 HP, type K-5362, 3 phase, 60 cycles, 220/440 volts. 1200 RPM, Squirrel Cage.
Complete with DC Panels & AC (220 volts) Reduced Voltage Automatic Starters.

EMPIRE ELECTRIC CO., INC. 87 JAY STREET, BROOKLYN 1, N. Y.

VARIABLE SPEED DRIVES
FREQUENCY CHANGERS
LOW-VOLTAGE GENERATORS
American ELECTRIC CORPORATION
DEPT. P, Box 133, INDIANAPOLIS, IND.

3000 KW., 400# psig., WESTINGHOUSE, 700°F.TT. Turbo-Generator

A Complete Perfect Condition Unit: IMMEDIATE DELIVERY

A VERY UNUSUAL OFFERING

WRITE TODAY FOR COMPLETE DATA

Above is Westinghouse Condensing 3000-KW. @ 80% PF., 3750-KVA., 400# psig., 700°F. TT., Voltage 3/60/2300/4160. Auxiliaries, 5500-sq. ft. Westinghouse, 2-pass Surface Condenser, Switchboard with Instruments with DC. Control Panel, 35-KW. Direct Connected Exciter, 3500-GPM. Circulating, also Condensate, pumps, both Motor operated, set of 2-stage Air Ejectors. A Very High Grade Unit in Splendid Condition throughout. Send for Drawings Today. Immediate Delivery.

OUR SPECIALTIES: Turbo-Generators, Boilers, Diesel Engines. We Carry Large Stocks in These Three (3) Lines at all Times.

BELOW IS A PARTIAL LIST OF OUR PRESENT STOCK.

TURBO-GENERATORS: ALL 3600 RPM

CONDENSING

No.				
1	500-KW.	A.-C.	150/200 psig.	480-V
2	500-KW.	G.-E.	150/200 psig.	480-V
3	625-KW.	G.-E.	160/200 psig.	480-V
4	750-KW.	A.-C.	150/200 psig.	480-V
5	750-KW.	West.	140/200 psig.	2300-V
6	750-KW.	A.-C.	150/200 psig.	2300-V
7	750-KW.	G.-E.	150/200 psig.	480-V
8	1000-KW.	G.-E.	175/250 psig.	2300-V
9	1000-KW.	A.-C.	125/200 psig.	2300-V
10	1500-KW.	A.-C.	150/200 psig.	2300-V
11	1200-KW.	G.-E.	175/200 psig.	2300-V
12	2000-KW.	G.-E.	150/200 psig.	2300-V
13	2500-KW.	G.-E.	150/250 psig.	2300-V
14	3000-KW.	G.-E.	150/250 psig.	480-V
15	5000-KW.	G.-E.	150/200 psig.	2300-V

NON-CONDENSING

No.				
1	500-KW.	A.-C.	125#:10/15 BP.	480-V
2	500-KW.	G.-E.	175#:10/15 BP.	480-V
3	500-KW.	West.	250/400:125# BP.	2300-V
4	750-KW.	G.-E.	125#:10# BP.	480-V
5	1000-KW.	G.-E.	125#:15 BP.	480-V
6	1250-KW.	G.-E.	200/250 psig. 20# BP.	480-V
7	2000-KW.	West.	250/350#:35# BP.	2300-V
8	2500-KW.	G.-E.	150/175#:15# BP.	2300-V
9	3000-KW.	A.-C.	425#750F:60# BP.	13200-V
10	4000-KW.	G.-E.	425#, 75° FSH. 60# BP.	13200-V

BOILERS, ETC.

1—Springfield. Same as NEW, 615-HP., 42,500# Steam per Hr., operated 60 days only. Working pressure 275#. Riley Hoffman Stoker. Complete with all Trim.

2—B&W, 1000-HP, 225 working pressure. Excellent condition.

2—B&W, 604-HP., Good for 25%—Continuous overload rating or 750-HP. Above are Sectional Headers.

PLEASE SEND YOUR SPECS. FOR: DIESEL ENGINES, BOILERS, MOTOR GENERATORS, PUMPS.

Our New Complete Stock List Just Recd. A Postal Brings It.

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WRITE OR
TELEGRAPH

CHARLES WEAVER

4145 Penobscot Building, Detroit 26, Michigan

Telephones:
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RE-NU-BILT BELYEA MOTORS

THE TRADE MARK WITH A MEANING
SUCCESSFUL OPERATION GUARANTEED
44th YEAR OF SERVICE—MEMBER OF A.R.A.*

MOTOR GENERATOR SET
3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G. E.	514	600	13800/4000
2	2000*	G. E.	500	600	6600/11000
3	1500	G. E.	514	250	4000/13200
1	1500	G. E.	720	600	6600/13200
1	1500	G E.	360	275	2300/4400
1	1500	G. E.	600	600	2300/4150
1	1500	C.W	514	115	2300
1	1200	A.C.	720	550	2300
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	6600
1	1000(3U)	G.E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	750	C.W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	900	250	6600/13200
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	350	G. E.	900	125	2300/4150
1	150	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G. E.	1175	125	440
1	140(3U)	Cr.-Wh.-	690	125/250	2300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
1	75	G. E.	1200	125	4000
1	50	Whse.	1775	575	208

*25 Cycle

ROTARY CONVERTERS

1—2000	G E.	514	600	13800
1—1000	Whse.	900	600	11000

TURBO GENERATORS

Qu	KW	Make	Desc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
	750	G. E.	Condensing 425#-725*TT I.S.P. 440 V. 3 ph. 60 cy New — 1944
	750	Whse.	Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.
	500	Moore	Non-condensing — 150/200 lbs. ISP 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter.
	500	G. E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
	400	Whse.	Non-condensing 125/150# I.S.P. 5/10# G.B.P., 240/480v. 3 ph. 60 cy.
	300	G. E.	Non-condensing 10/175# I.S.P. 5/15# B.P. 480V. 3 ph. 60 cy.
	200	Whse.	Non-condensing 150# I.S.P. 7# B.P. 240 V. 3 ph. 60 cy.

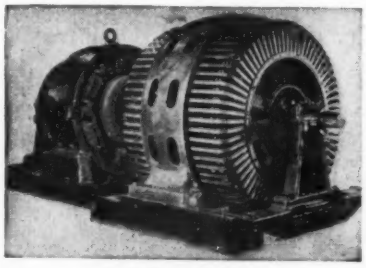
3—1500 KW—250 V. D.C.—13200 V. A.C.
NOW AVAILABLE.

D.C. MOTORS

Qu.	H.P.	Make	Type	Volts	Speed
1—	2200	G. E.	MCF	600	360/500
1—	2000	Whse.	Mill	600	230/460
1—	910	Whse.	QM R Brg.	250	140/170
1—	900	Whse.		250	450/550
1—	600	Al. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G. E.	MCF	550	300/1050
1—	300/400	G. E.	DYNA	250	1325/2500
2—	300	Whse.	CB-5094	230	575/1150
1—	200/300	G. E.	MPC	230	360/920
1—	250	G. E.	MPC	230	400/500
1—	200	Rel	1970T	230	720
1—	200	Whse.	CB-5113	230	400/800
1—	150	G. E.		600	250/750
10—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
1—	150	Whse.	SK-151 B	230	900/1800
1—	150	Whse.	CB-2073	230	525/1150
1—	150	Whse.	CB-5093	230	300/1200
1—	50/120	G.E.	MFC	230	250/1000
2—	100	Whse.	SK-181	230	450/1000
1—	60	El. Dy.	25-S	230	525/1050
2—	50/60	Whse.	SK-170	230	400/1200
1—	50	G. E.	CO-1810	230	725
1—	50	Whse.	SK-170	230	350/1050
2—	50	G. E.	RCP-31B	230	1700

FREQUENCY CHANGERS

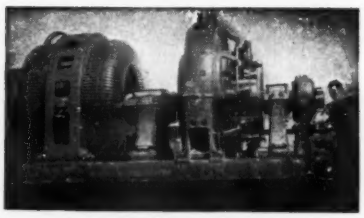
Qu.	KW	Make	Cycles	Voltage
1—	3000	G. E.	25/60	4000/2300x2300/4000
1—	2000	G. E.	25/62½	2300/4160
1—	2000	Whse.	25/62½	2300/2300
1—	1000	G. E.	25/58	4400/2300
1—	500	A. C.	25/60	11000/2300V



500 KW MG SET
IN STOCK

TRANSFORMERS
60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66000x13800
3	1000	G. E.	H	1	2200x480
1	1500	G. E.	HT	3	13200x2300
3	1250	G. E.	H	1	6600x550
1	1150	A. C.	OISC	3	13200x2300/480
2	1000	Pitts.	OISC	3	2300x460
1	500	Whse.	OISC	3	13400x216
4	300	G. E.	HT	3	2400x240/480
3	200	Whse.	O15C	1	13200x120/240
3	150	Whse.	OISC	1	33000x2300/4000
3	100	G. E.	OISC	1	2400x120/240
2	75	Upte	OISC	3	4160x240
1	50	Mol.	Askerel	3	13200x120/208
3	10	G. E.	H	1	2300x115/230
9	7½	G. E.	H	1	2300x115/230



2000 KW—MG SET
IN STOCK

A. C. MOTORS
3 ph. 60 Cycle
SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1—	5000	Whse.		2500/5000	600
1—	4350	Cr. Wh.		4160/13800	514
2—	3500	G. E.	TS	2300	257
1—	2500	G. E	ATI	2300	720
2—	2100	G. E.	ATI	2300	360
2—	2000	Whse.		2300	120
2—	1750	G. E.	ATI	2300	3600
3—	735	G. E	ATI	2200/12000	600
1—	500	Ideal	SM	2300/4150	1800
1—	450	Whse.	Eng.	2200	128.5
1—	450	Whse.		2300	450
2—	350	G. E.	TS	2200	150
1—	300	Whse.		2300	720
1—	150	Whse.		440	600
1—	100	Whse.		550	600
1—	100	F.M.		220	1200

SLIP RING

1—1800	G. E	MT-498	2300	360
1—1500	ABB		2300	720
1—1200	G. E.	MF-26	2300	275
2—1000	A.C.	Mill	2300	240
1— 500	Whse.	CW	500	360
2— 500	G. E. unused	M-574Y	2200	900
1— 500	G. E.	IM	440	900
1— 400	Whse.	CW-1218	2200	435
1— 400	Whse.	CW	440	514
1— 350	G. E.	MT-442Y	2300/4000	253
2— 300	G. E	MT-565Y	2300	900
1— 300	A. C		410	514
1— 300	A.C.		440	505
1— 250	G. E.	MT-424Y	4000	250
1— 250	G. E.	MT-559S	2200	1750
1— 250	A. C.		550	600
1— 200	Cr. Wh.	26QB	440	505
1— 200	G. E.	IM	410	435
1— 200	G. E.	MTP	410	1170
1— 200	Whse.	CW	410	490
1— 200	G. E.	IM	440	600
1— 150 new	Whse.	CW	2300	450
1— 150	G. E.	IM-16	440	600
2— 125	A.C.		440	865
1— 125	A. C.		440	720
4— 125	G. E.	MT-566Y	440/2200	435
1— 100	G. E.	IM-16	2200	435
1— 100	G. E.	IM	440	600
3— 100	Al. Ch.	ANY	440	695

SQUIRREL CAGE

2— 650	G. E.	FT559BY	440	3750
2— 450	Whse.	CS	2300/4150	354
1— 200	G. E.	IK-17	400	580
3— 200	G. E.	KT557	410	1800
1— 200	G. E.	KT-559Y	2300	1200
1— 200	G. E.	IK	440	865
1—75/150	G. E.	IK	440	450/900
1— 150	Whse.	CS	440	580
1— 150	Weighse.	CS8568	410	830
1— 125	Whse.	MS	440	485
1— 125	G E.	KF-TEFC	440	3585
2— 125	A.. Ch.	ARW	2200	1750
1— 100	G. E.	IK-Vert.	2300	150
2— 100	G. E.	IK	440	580
2— 100	G. E.	IK	440	580

*American Rebuilders Association — Member Body of A.S.A.

BELYEA COMPANY, INC.

OFFICE AND SHOP
43 HOWELL ST., JERSEY CITY 6, N. J.

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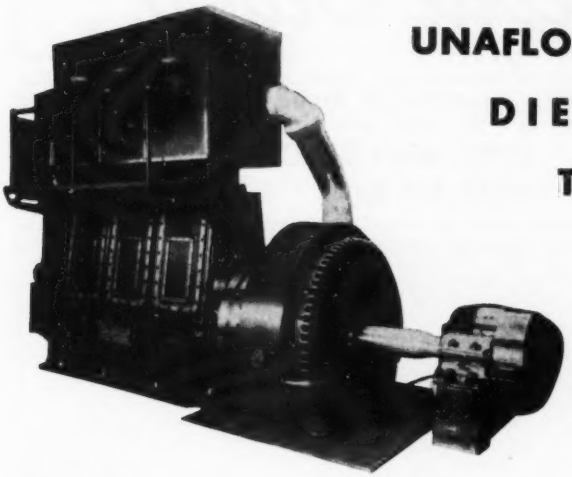
SPECIAL BARGAIN OFFERINGS

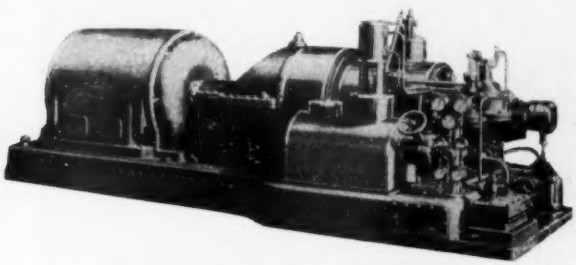
UNAFLOW ENGINE GENERATORS

DIESEL GENERATORS

TURBO GENERATORS



500 KVA G.E.
240 VOLT SKINNER VERT. UNAFLOW



937 KVA ALLIS CHALMERS 480 VOLT
NON CON. UNIT

TURBINE GENERATOR UNITS

Condensing—3 phase, 60 cycle

6250 KVA G.E., 5-stage, 2300/4160 volts, 200# PSI, 600°TT.
6250 KVA Westghse., 480 volts, 400 PSI, 15# G. extract with condenser.
5000 KVA Westghse., 600 volts, 275 PSI, 25# G, extract with condenser.
3750 KVA Westghse. 2300 volts, 200 PSI.
2500 KVA G.E., 2300/480 volts, 3600 RPM, generator **LESS TURBINE.**
1000 KVA G.E., 450 volts, 275-400 PSI, 750°TT geared unit.
940 KVA Westghse., 2300 volts, 180 PSI, mixed pressure automatic extraction.
940 KVA Elliott, 2300 volts, 3600 RPM generator **LESS TURBINE.**
781 KVA Allis, 48 0volts, 150 PSI.
625 KVA Elliott 2300 volts, 250 PSI, MODERN.

Non-condensing—3 phase, 60 cycle

5000 KVA G.E., 13,800 volts, 600 PSI.
1563 KVA (1) G.E. 480 volts, 200 PSI, to 20# ga. back.
1250 KVA (2) G.E., 2300 volts, 150 PSI, 10# gauge back.
937 KVA ALLIS 480 VOLTS, 150#, 10# gauge back, excellent condition (photograph above).
625 KVA G.E., 2300 volts, 150 PSI, 40# gauge back.
500 KVA Terry, 480 volts, 325 PSI, 110# back.
125 KVA Westghse., 2400/480 volt, 125-250#, 5# ga. back. Geared unit.

UNAFLOW GENERATOR UNITS

3 phase, 60 cycle

750 KVA E.M. 240/480/600 volts generator connected Skinner Vertical engine, 150 PSI, 8# gauge back.
575 KVA G.E., 2300 volts generator connected Nordberg engine 200# PSI.
500 KVA G.E. 240 volts generator connected Skinner Vertical engine, 150-175 PSI complete. (actual photograph above).
375 KVA Westghse., 2400/480 volts connected Ames Vertica lengine.
375 KVA Westghse. 600 volts connected Skinner engine, 150 PSI, 10# back.
312 KVA G.E. 240 volts connected Skinner engine, 125 PSI, 5# back.

DIRECT CURRENT UNITS

540 KW Westghse. non-condensing turbine 250 volts D.C. NEW, 200# PSI.
400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.
300 KW Westghse. 3-wire, 250 volts 150/250# PSI noncondensing turbine.
300 KW (2) Westghse, 3-wire, 240/125 volts condensing turbines. 440# PSI.
250 KW Crocker Wheeler 125 volts generator direct connected Ames vertical non-condensing engine 150#.
100 KW G.E. 120 volts condensing or non-condensing geared 200-275 PSI.
1 60 KW (6) Elliott 125 volts condensing or non-condensing 200-250 PSI.

DIESEL GENERATOR UNITS

3 phase, 60 cycle

1250 KVA (3) Elliott 2300/4160 volts, 720 RPM connected to G.M. Model 16-278A engines. NEW.
1000 KVA G.E. 2400 volts, generator connected to Enterprise engine.
937½ KVA G.E. 2400 volts generator connected General Motors engine.
875 KVA Westghse. 2400/4160 volts, 327 RPM generator connected De-Lavergne engine.
750 KVA G.E. 2400 volts, generator connected to Enterprise engine.
400 KVA (3) Elec. Mchy. 440 volts generators each connected to 6 cylinder Alco engine. Complete.
375 KVA F.M. 2300 volts, 300 RPM Model 32-E-14.
375 KVA E.M. 480 volts, 600 RPM generator connected Buckeye engine complete.
250 KVA (2) Westghse. 220/440 volts generator connected to Buckeye engine.
185 KVA F.M. 2300 volts, 300 RPM connected Fairbanks 32-E-14 engine 1948, reconditioned, guaranteed.
20 KW Louis Allis, 125 volts generator connected 64 HP Hill engine.

SPECIALLY PRICED

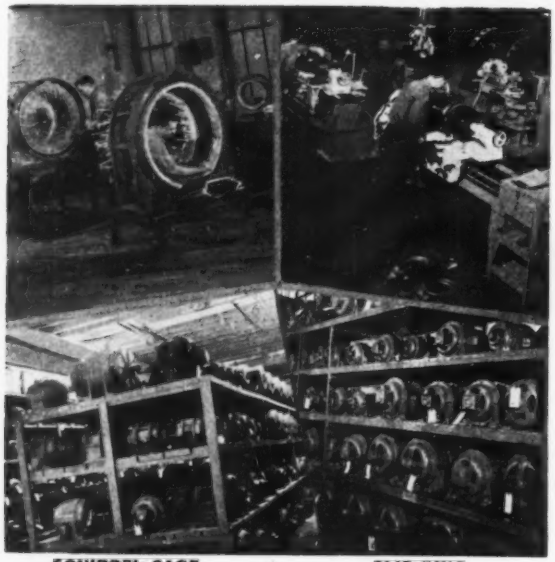
- **5000 KVA Westghse. synchronous condenser 3 phase, 60 cycle, 4000 volts 720 RPM.**
- **150,000# per hr. B&W cross drum water tube boiler 250# pres. 125°F superheat. Taylor Stoker.**
- **547 HP B&W Sterling water tube boiler 225# pres. built 1938.**

UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • CH. 1-0210

MARCH 1953

CHICAGO Electric Digest

PUBLISHED BY CHICAGO ELECTRIC CO. • THE HOME OF GUARANTEED REBUILT POWER EQUIPMENT



SQUIRREL CAGE

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*220 volts or higher)

HP	Make	Type	Speed
1750	*G. E	K	3600
1000	*G. E	K6347S	1800
750	*A. C	TEFC	1800
750	*G. E.	KT	720
700	G. E.	FT	3600
500	*G. E.	PBG	3600
500	*A. C.	6316SW	1800
450	*G. E.	KF567S	1200
400	*Westgh.	CS	1800
400	*G. E.	KTP562	1800
400	A. C.	ANW	900
400	*G. E.	IK	514
350	*Cr-Wh BBDP	SC	3600
300	*Westgh.	CS	3600
250	*L. Allis	OGS	1800
250	*L. Allis	OGX148S	720
250	G. E.	IK	600
200	*G. E.	FT549Y	3600
200	*G. E.	IK13B	1800
200	A C	ARWWT	600
200	G. E.	IK-17	600
150	*A. C.	AN	1800
150	G. E.	IE-K	1800
150	*G. E	IK	600
150	A. C.	AR	325
125	Westgh	CS504S	3600
125	*A. C.	AR226	1800
125	G. E.	IK	1200
100	*G. E	FT542Z	1800
100	Westgh.	CS	1800
100	A. C.	AW	1200
100	G. E.	IK13A	1200
100	U. S.	CFU(Vert)	1200
100	*Westgh	CS(Vert)	1200
100	A. C	AN	900
100	G E.	IK15A	514
75	Westgh.	CS445S	3600
75	A. C.	AN	1800
75	Westgh	CS645C	1800
75	G. E.	KT346	1200
75	G. E.	IK	1200
75	Westgh.	CS	900
75	*A. C	AR(Vert)	900
75	A C.	AN	720
75	G. E.	IK	600
75	*Triumph	TR16	514
75	G. E.	IK	514
60	*Westgh.	CS504S	1800
60	A. C.	APZ445S	1800
60	A. C	APZ504U	1200
60	G. E.	KT343	1200
60	A. C	AR823	900
60	A. C.	AR826F	514

Hundreds of smaller motors!
WRITE FOR STOCK LIST

SLIP RING

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

2000	*G. E.	MT-12	600
1500	*G. E.	MT30	240
1250	*Westgh	CW	600
1000	*Westgh	CS	250
700	*A. C.		720
500	*G. E.	IM	3600
500	*G. E.	MTP	1800
500	G E	IM	720
500	Westgh.	CW	350
400	A. C	3-brg	450
400	*G. E.	MT412	450
300	*G. E.	IM15A	1800
300	*G. E.	MT410	450
250	Westgh.	HF15H	600
200	G. E	IM	1800
200	G. E.	IM15	1200
200	Westgh.	CW	600
150	Westgh.	CW772C	1200
150	*G. E.	IM16	600
125	*G. E.	MT549	1800
125	G. E.	IM15A	600
100	A. C.	ANY	900
100	G. E.	IM15A	450
75	Nwstrn.	HW50	1800
75	G. E.	MT347	1200
75	G. E.	MT356	900
75	G. E.	IM	900
75	G. E.	IM	720
75	G. E.	IM14	600
60	Westgh.	CW762C	900
50	G. E	IM11A	1800
50	*A. C.	ARY	1800
50	Westgh.	CW636A	1200
50	G. E	MT346	720
50	G. E.	IM14	450
40	*G. E.	MT532	1200
40	G. E.	MT336	1200
40	Westgh.	CW644	900
40	G. E	M504U	900
35	Fbks-M.	UAB(Vert)	1800
35	G. E.	IM	1200
30	G. E.	MT532	900

CHICAGO ELECTRIC STOCKS UNITS OF EVERY SIZE AND TYPE

CHICAGO ELECTRIC's modern plant houses one of the nation's largest stocks of guaranteed rebuilt power equipment . . . AC & DC MOTORS, M. G. SETS, GENERATORS, CONVERTERS, COMPRESSORS, HOISTS, PUMPS, TRANSFORMERS, CONTROLS and other allied equipment . . . so, whatever you need and whenever you need it . . . be sure to check with CHICAGO ELECTRIC firsts!

M. G. SETS

KW	Make	AC	DC
2400	A. C.(3-unit)	4800	525
2400	Westgh. "	4800	600
1000	G E. "	11000	137½/275
1000	Westgh. "	11000	137½/275
500	A. C.-West.	2300	250
500	Cr-Wh.	220/440	250
450	G. E. (3-unit)	2300	125/250
400	A. C.	2300	120/240
250	West.-G. E.	440	250
200	Ridgeway	2200	250
150	G. E.	2300/440	250
150	G. E.	2300/4000	125/250
150	G. E.	440	275
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	Delco-G. E.	440	120/240
90	G. E.	440	60
75	A. C.	440	250
60	A. C.	2300	110
60	G. E.	440	250
40	Cr-Wh.	220	125
40	A. C.	220	125
40	G. E.	220	125
35	G. E.	440	125
25	Westgh.	2200	125
25	G. E.	220	275
20	G. E.	440	250
20	Bogne-GE	440/550	250
20	Bogne-GE	220/440	250
20	Bogue-GE	220/440	125

DC to AC

100	G. E.	230	235
75	Westgh.	2300	110
12½	Westgh.	240	115

D. C. MOTORS

Mill Type—Pedestal Bearing Reversing

HP	Make	Volts	Speed
3000	Westgh (Tandem)	525	600
1750	Westgh	600	550
1500	Westgh	525	600
1200	Westgh	525	600
1000	Westgh	450	600

Mill Type—Non-reversing

HP	Make	Type	Speed
1500	Westgh (600v)		200/400
700	Westgh (600v)	MCF	150/525

230 Volts—Constant Speed

175	G. E.	ELC	750
125	G. E.	Marine	1200
100	G. E.	RC34	2500
100	G. E.	RC19	575
75	G. E.	MDS106	485
60	G. E.	CD-115	860
50	G. E.	RC35	700
40	Cr-Wh.	CMC	1750
50	G. E.	CO2004	600
35	Cr-Wh.	CM351	700
30	G. E.	MD104½	725
30	Cr-Wh.	CCM	440
25	G. E.	CD93	1200
25	G. E.	RC32	800
25	Westgh.	SK100L	1100
25	Westgh.	SK133	575

Many others—1 HP and up
Also Variable-Speed and 115 Volts

Phone: CAnal 6-2900

CHICAGO Electric Co.

1320 West Cermak Road, Chicago 8, Ill.

AC SYNCHRONOUS

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	P.F.	Spd
2500	*A. C.		1.0	514
1420	*Westgh.		.7	900
720	*G. E.(25 cy)	ATI	1.0	750
700	*G. E.	TS975Z	1.0	1200
600	*G. E.	TS7640	1.0	900
600	*G. E.	ATI	1.0	240
400	Westgh.	HG	1.0	900
300	G. E.	ATI	.8	900
300	*G. E.	ATI	1.0	720
300	Ideal	SNS	1.0	257
190	Elc-Mch	2S	1.0	720
175	*Westgh.	HR	1.0	360
150	*Westgh.	HR	.8	900
125	G. E.	ATI	1.0	900
125	*Elc-Mch		1.0	900
125	Cr-Wh.	103S	1.0	900
125	*G. E.	TS	1.0	277
115	Elc-Mch	EM	1.0	240
100	Cr-Wh.	103S	.8	900
100	*G. E.	ATB	.8	900
100	Westgh.		1.0	900
100	Ideal	SNS	1.0	900
100	G. E.	TS6184	1.0	450
40	G. E.	ATB	.8	1200
20	Fynn-W	15VRN		1200
15	Ideal			1800
15	Century	ARC365	1.0	1200
7½	Ideal			1800

AC SYNCHRONOUS

GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volt (*2200 volts or higher)

KVA	Make	Type	P.F.	Spd.
3500	*G. E.		.8	720
1750	*Westgh.		.7	900
1500	G. E.	ATI	.8	720
312	G. E.	ATI	.8	900
300	*G. E.	ATI	.8	720
225	G. E.	ATB	.8	600
187	Westgh.	ES	.8	720
112½	*G. E.	ATB	.8	1200
110	Cr-Wh.	103	.8	900
100	*G. E.	ATB	.8	900
60	Fbks-M.	B	.8	900
55	G. E.	ATB	.8	1200
50	G. E.	ATB	.8	1200
50	Westgh.		.8	1200
50	G. E.	ATB	.8	900

ENG. GENERATOR SETS

KVA	Make	Type	Volts	Spd.
300	Gen. Motors	8-268A	480	1200
100	Gen. Motors	6-71RC	480	1200
100	Gen. Motors	3-268A	480	1200
31	Cummins-Rogers	H-I-6	120/208	1200
25	LeRoi	20-A	120	900

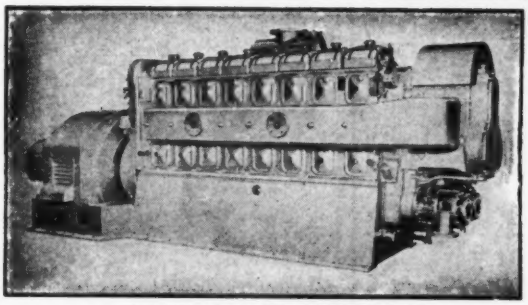
TRANSFORMERS

KVA	Make	Phase	Pri.	Sec.
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
667	G. E.	1	33000	480
333	A. C.	1	14400	240/480
300	G. E.	3	13800	240/480
300	G. E.	3	2400	240/480
200	Wagner	1	2400	575
167	A. C.	1	2400	120/240
100	Pittsbgh.	1	2400	575
100	A. C.	1	2400	120/240

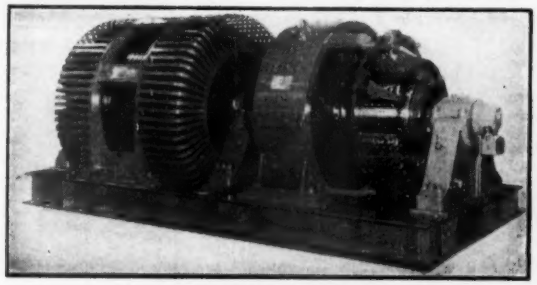
"THE O'BRIEN STORY"

KNOWLEDGE . . . FACILITIES . . . CAPITAL . . . EXPERIENCE . . . these are the requisites around which The O'Brien Story is built. With over 37 years of experience and know how in Manufacturing, Rebuilding, Reconditioning and Distributing Industrial Machinery of all types The O'Brien Machinery Company has expanded until today we are, in addition to being Philadelphia's leading Machinery dealers and exporters, one of the nation's outstanding Machinery houses. Our facilities consist of over 100,000 sq. ft. of fully equipped shops and warehousing space manned by our complete staff of graduate mechanical and electrical engineers, competent buying and selling personnel, trained electricians and skilled machinists. Our representation is both national and international, and our service facilities are linked from coast to coast. The name O'Brien in the machinery industry stands for quality and integrity which is the keynote of our success. "Know the integrity of your dealer and you will know the quality of your machinery."

Read More About "The O'Brien Story," In the next Issue of Power.



375 KVA GM DIESEL GENERATOR SET



500 KW WEST. MOTOR GENERATOR SET

MOTOR GENERATOR SETS

1500 KW G.E. 250 volt 3/60/2300/360 RPM
1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels
1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #813047 (year 1935) See actual photo above.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
200 KW Elliott 250 Volt 1200 RPM 3/60/Any Voltage.
2—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch., 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW G.E.—C.D.—125 Volt D.C. 150 HP GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—50 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.
Smaller Sizes and Types—Advise Requirements

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	1000	GE	13200	2300	1
1	1000	Penna.	13200	480	1
1	1100	West.	4160	440	3
3	750	West.	2300	230	1
3	500	GE	13200	2300	1
3	333	(New)	2400	480	1
3	333	GE	13200	2300	1
3	250	West.	13200	2300	1
3	200	GE	7200	120/240	1
3	200	GE	13200	2300	1
3	200	Mal.	2300	220/440	1
3	200	GE	13200	2300	1

OISC TRANSFORMERS (Con't)

3	200	GE	7200	2300	1
3	150	GE	33000	220/440	1
3	150	Niag.	2400	240/480	1
3	100	West.	11000	480	1
3	100	GE	7200	120/240	1
2	100	GE	2300	115/230	1
3	75	Mal.	2300	115/230	1
3	50	GE	13200	120/240	1
3	50	GE	13200	2300	1
4	37½	West.	2400	240/480	1
3	25	West.	2300	115/230	1
3	25	West.	6900	2300	1
2	15	GE	2400	120/240	1
3	10	GE	220	110	1
10	1½	GE	2400	120/240	1

DIESEL & GASOLINE GENERATOR SETS

6—875 KVA G.E.—Busch Sultzer 3/60/2300/275 RPM, Complete Plant, 1940
1—375 KVA GM 8-268A, 3/60/480/1200 RPM
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
1—125 KVA Hercules. 3/60/220/440/1500 Hrs.
1—56 KVA Climax Gasoline, 3/60/220/1200.
2—45 KVA Chry. New 6 Cyl. 3/60/220/440.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	600	West.	CS	2200	600
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
2	400	G.E.	IK	2300	1800
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	250	G.E.	IM	2300	450

PLATING SET

4000/8000 amp. 6/12 v. D.C. 600 RPM Hanson Van Winkle Munning 75 HP 1.0 pf., syn. motor 3/60/220 direct drive. Built in exciter complete with Cutler Hammer magnetic starter. New 1946.

ELECTRIC MOTORS (Con't)

1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200
2	100	G.E.	Syn.	440	300
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

TURBO GENERATORS

1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.
1—200 KVA Moore Non-Condensing 3/60/480, 195 PSI, 100° F, 100# BP. Year 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

DIESEL GENERATORS

200 KW G.M. Twin 6-71, 240 D.C. Rad. Cooled Elec. Start.
1250 KVA Nordberg 3/60/2300/360 RPM 1940
250 KVA G.M. Twin 6-71, 3/60/220/440/1200 RPM Rad. Cooled.

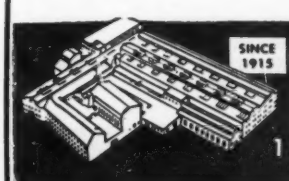
AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 lb., direct 250 H.P., 440/3/60/3600.
1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 930 HP Syn. 1 P.F. 2300/60/3.
1—4690 CFM I.R. PRE-2 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.
1—3000 CFM GE Turbo 5 lb. direct 90 HP 440/3/60/3600.
1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—968 CFM Sullivan 13x13x8, 50 psi.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.
1—868 CFM Sullivan 17x10x12, 100 psi.
1—528 CFM Ing. Rand 14x12, 100 psi.
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—173 CFM Pa. 3A—9x8, 100 psi.
1—122 CFM Worth. 7x7, 100 psi...
1— 89 CFM I.R.—ES 16x7, 150 psi.

BOILERS

1—60 H.P. Ames Package 125 psi, 1947.

"Everything from a Pulley to a Powerhouse"



SINCE 1915

THE O'BRIEN MACHINERY CO.

PHILADELPHIA'S LEADING MACHINERY DEALERS & EXPORTERS

1547 N. DELAWARE AVE., PHILADELPHIA 25, PA.

• Telephone GArfield 6-1150 • Cable Address O BRIEN PHILA.

AFFILIATED WITH SOC EXPANSO INDUSTRIAL SOL AMERICANA LTDA RIO DE JANEIRO—BRASIL

WORLD'S LARGEST INVENTORY

Established 1934 — D & B Rated

MARCH BULLETIN

TRANSFORMERS—WORLD'S LARGEST INVENTORY

All Single Phase Unless Otherwise Noted.

KVA		PV	SV
1—6000	3 ph.	24000	5040/4800
1—3750	3 ph.	22000	600
1—3750	3 ph.	22000	440
1—3000	3 ph.	22000	440
1—3000	3 ph.	22000	480
3—2500		27600	2300
4—1000	3 ph.	13800	600
3—1000	3 ph.	13800	480
5—1000		13800	230/460
1—1000	3 ph.	2200	220 Delta
3— 833		2300	575
2— 833		13800	460
3— 800		22000	2200
4— 750		2200	244/488
2— 667		13200	2300
1— 667		13200	480
3— 667		6600	2300
1— 500	3 ph.	4000 WYE	460 delta
1— 500		4600	460
2— 500		11000	2300
3— 500		11400	40/80
3— 500		13800	460
6— 500		33000	6600/2300
1— 450		11000	230
1— 450		11000	460
3— 450		23000	445
3— 400		2200	244/488
2— 400	3 ph.	2300	230
5— 333		22000	2400
2— 333		11500	115/230
3— 333		2400	240/480
3— 333		2400	120/240

3—1250 KVA, G.E. transformers, 11,000 Pr. V. with 4 taps on 33,000, 2200 Sec. V., 25 cy. 1 ph. (O.K. for 60 cycle). Ser. 2,297,476-7-8.

PARTIAL LIST—2000 UNITS IN STOCK FROM ONE TO 333 KVA
ALSO
AIR COOLED AND SWITCH GEAR

MOTOR GENERATOR SETS AC — DC

Quan.	KW	Make	Volts
1	1500	G. E.	300
2	1000	G. E.	600
1	1000	G. E.	250
1	1000	West.	250
1	750	Al. Ch.	275
1	600	G. E.	250
1	500	West.	125
3	500	West.	250
2	500	G. E.	250/275
1	500	G. E.	275
1	400	West.	125/250
1	400	West.	500
1	325	G. E.	500
2	300	West.	275
1	300	West.	550
2	200	West.	600
1	200	West.	250
1	170	G. E.	125
1	150	West.	125/250

Plus 238 sets from 1 KW to 150 KW in stock.

Cash for Your Surplus

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	1200	237	Cr. Wh.
1	600	1800	G. E.
1	500	1800	G. E.
1	400	514	G. E.
1	400	435	West.
1	300	500	G. E.
1	300	450	G. E.
2	250	600	G. E.
1	250	480	G. E.
2	200	600	G. E.
3	200	450	Burke
3	150	720	G. E.
1	150	450	G. E.
1	125	435	G. E.
6	100	450	G. E.
1	100	900	G. E.

Plus 837 smaller units 1 HP to 75 HP

Sorry—boys—can't—make—it.

SQUIRREL CAGE—60 CYCLE

HP	Speed	Make
500 (3)	514	West.
450	720	G. E.
400 (2)	514	West.
300	600	West.
250 (2)	3600	G. E.
250	1200	Al. Ch.
250 (6)	900	West.
250 (2)	720	Open
200 (2)	1800	West. TEFC
200 (3)	1800	Wag., Rel.
200	1800	G. E.
200	600	Al. Ch.
150	900	G. E.
150	400	G. E.
125 (5)	1800	Al. Ch.
100 (2)	1800	West.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

AC GENERATORS—ALTERNATORS—CONDENSERS

Quan.	KVA	HP	RPM	Cycle
2		2500	720	60
1		1675	600	40
2		1500	900	60
1		1500	1200	60
1		1430	514	60
3		1250	720	60
1		1250	1200	60
2		1000	600	60
1		1000	750	60
1		1000	750	25
1		800	900	60
1		720	900	60
2		650	139	60
1		500	720	60
1		412	225	60
1		400	450	60
3		400	1800	60
1		375	750	25
2		375	1200	60
1		350	720	60
1		300	750	25
1		312	1200	60
1		300	180	60
1		280	1200	60
1		250	900	60

Plus 78 smaller units from 3 KVA to 250 KVA

CONSTANT SPEED—230 V.

HP or KW	Make	Speed
500 KW (2)	West. 125/250 V.	900
400 HP	El. Dyn.	1500
400 HP	G. E.	450
360 KW	G. E. 180 V.	1300
300 KW	West. 125/250 V.	1200
300 KW	G. E. 170 V.	1200
250 KW	Al. Ch.	750
150 KW	West. 125/250 V.	750
150 KW	G. E.	1200
150 HP	West.	1615/1785
125 HP	Star	1200
120 KW (2)	G. E.	1250

Plus 675 smaller units 1 HP to 120 HP also 115 V. & 550 V. DC.

DC—ADJ. SPEED—230 V.

Quan.	HP	Make	Speed
1	3600	Dynam.	800/2000
1	650	G. E.	750/2000
1	300	G. E.	400/ 800
1	250	West.	250/ 675
4	250	West.	540/3000
1	125/190	G. E.	260/ 400
1	150	West.	320/ 580
1	150	Rel.	400/1200
1	100/150	West.	500/ 750
1	100	G. E.	1050/4000
2	100	Rel.	575/1150
2	100	West.	450/1000
1	60	El. Dyn.	525/1050
2	30/71	West.	450/1000
1	50/60	G. E.	220/1000
2	50	Diehl	400/ 800
1	25/50	G. E.	300/1200
1	35	G. E.	250/1000
1	30	West.	500/1000
1	30	West.	700/1750
1	30	Rel. TEFC	400/1200
3	25	G. E.	500/1500

Plus 327 smaller units 1 HP to 25 HP

ELECTRIC EQUIPMENT COMPANY

PHONE LD65

New and Rebuilt **ROCHESTER, N. Y.** *1 H. P. to 2500 H. P.*

MOTORS · MG SETS · TRANSFORMERS · CONTROLS · COMPRESSORS

ELECTRIC MOTORS AND GENERATORS

WAGNER CERTIFIED REBUILT

BACKED BY 47 YEARS OF QUALITY AND SERVICE

ANOTHER CUSTOMER TELLS WHY—

IT PAYS TO

"Check with Wagner First"

WAGNER *"Certified Rebuilt"* MEANS:

1. Thorough Rebuilding
2. Careful Testing
3. Honest Guarantee
4. Save Money Safely
5. Quick Shipment
6. Complete Quotations

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis. Ch.	1 brg.	480	400
375	G.E.	ATI	240/480	1200
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G.E. 25 cycle	ATI	480	750
225	Gen. Elec.	ATB	240/480	600
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900
56	G.E.	ATB	240/480	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis Ch. b.b.	EW	350	1200
150	Whse.	SK191	125/250	900
125	Gen. Elec.	RC38	250	675
105	Century b.b.	1500 amp.	70	1200
100	Whse.	SK	250	900
100	Allis Ch.	E	125	1200
75	Cr. Wh. b.b.	CCD	250	1500
60	Whse.	SK160	250	1000
60	Gen. Elec.	LC	250	700
50	L.A. b.b.	GNA	240	1200
50	Allis Ch.	E131	250	1200
50	Allis Ch.	EW	125/250	1200
50	Gen. Elec.	RC	125	1200
40	Gen. Elec.	RC	600	1750
40	Gen. Elec.	RC	250	1150
25	G.E. b.b. New	CDM93	125	1500
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

D.C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	250	500
300	Allis Ch. b.b.	EW	350	1000
200	Al. Ch. b.b.	E	250	600/1000
150	Reliance	1050T	230	1200
150	Gen.Elec.	RC39	230	550
100	Whse.	SK	230	400/1200
75	Cr. Wh. b.b.	HH	230	1150
60/75	Gen. Elec.	C	230	500/1200
50	Gen. Elec.	CD123	230	550/1200
50	Al. Ch.	E-131	230	1150
50	Gen. Elec.	RC33	115	1100
40	Gen. Elec.	RC32	230	1100
30	Gen. Elec.	LC	230	500/1500
30	Whse.	SK110L	230	1150
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	G.E. b.b.	CDM93	115	1150
20	Whse. b.b. (2)	SK97	550	900

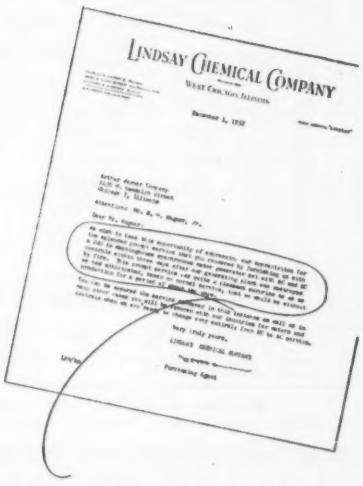
A. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
750	Whse.	Synch.	2200/4000	900
700	G.E.	Synch.	2200	514
600	G.E.	Synch.	220/440	257
500	G.E.	Sq. Cage	6600/4000	1800
500	G.E.	Synch.	440	900
500	G.E.	Slipring	2200/440	450
500	Al. Ch.	Synch.	440	400
450	Whse.	Synch.	2300	900
400	G.E.	Synch.	440	450
350	Whse.	Slipring	2300	450
350	G.E.	Slipring	440	720
300	Al. Ch.	Sq. Cage	2200/440	720
300	El. Mach.	Synch.	2200/440	360
300	G.E.	Sq. Cage	2300	1800
300	Whse.	Synch.	2200/440	600
300	G.E.	Slipring	2300	1800
300	Al. Ch.	Slipring	2300	514
300	G.E.	Slipring	440	360
250	G.E.	Sq. Cage	2300	450
250	G.E.	Slipring	2300	450
250	G.E.	Slipring	440	600
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L.A. (2)	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	600
200	G.E.	Slipring	220/440	514
200	G.E.	Sq. Cage	220/440	600
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Slip Rings	220/440	600
200	E.M.	Synch.	220/440	1200
200	G.E.	Sq. Cage	220/440	1200
200	Al. Ch.	Synch.	440	360
200	G.E.	Slipring	220/440	360
200	G.E.	Sq. Cage	220/440	1800
200	Rel. b.b.	Sq. Cage	220/440	1200
200	E.M.	Synch.	220/440	514
160	Whse.	Synch.	220/440	600
150	G.E. TEFC	Sq.Cage	2200	3600
150	Al. Ch.	Sq.Cage	2200	3600
150	G.E.	Slipring	220/440	600
150	Rel. b.b.	Sq. Cage	220/440	1200
		Slipring	2200/440	720
150	G.E. (2)	Sq. Cage	2200/440	720
150	G.E.	Slipring	220/440	450

M-G SETS

KW	Mfr.	Input V		Output V	
500	Whse.*	2300	AC	250	DC
360	G.E.*	2300/4000	AC	250	DC
350	El. Machy.	250	DC	480	AC
300	Allis Ch.	440	AC	125/250	DC
300	Whse.*	2300	AC	600	DC
250	Allis. Ch.	440	AC	350	DC
200	G.E.*	220/440	AC	250	DC
200	Gen. Elec.*	220/440	AC	125	DC
150	Whse.*	220/440	AC	125/250	DC
105	Century b.b.	220/440	AC	70	DC
100	Whse.*	2300/4000	AC	275	DC
100	Al. Ch.	220/440	AC	125	DC
100	Delco b.b.	220/440	AC	125/250	DC
100	Allis Ch.*	220/440	AC	50	DC
75	Whse.	440	AC	250	DC
60	Gen. Elec.*	220/440	AC	60	DC
50	Gen. Elec.	220/440	AC	125	DC
50	Allis Ch. (2)	220/440	AC	125/250	DC
45	Gen. Elec.*	220/440	AC	60	DC
40	Gen. Elec.	220/440	AC	250	DC
30	Otis (5)	220/440	AC	250	DC
25	Whse.	220/440	AC	125	DC
20	N.W.	220/440	AC	250	DC
20	Whse.	220/440	AC	600	DC
21	Whse.	220/440	AC	35	DC
17	Gen. Elec.	220/440	AC	125	DC

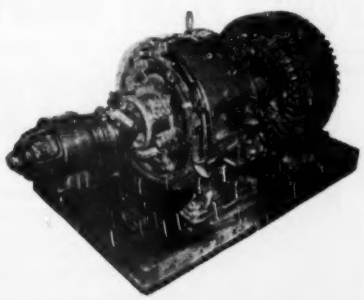
THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK.


LINDSAY CHEMICAL COMPANY

West Chicago, Illinois

December 1, 1952

"...expressing our appreciation for prompt service by furnishing us an M-G Set....within three days after our generating plant was destroyed by fire..."



The 200 KW Westinghouse synchronous motor generator set referred to in above letter from LINDSAY CHEMICAL CO.

Gearhead Motors — Controls — Transformers

Arthur Wagner Co.

1435 W. RANDOLPH ST. MOnroe 6-7409 CHICAGO 7, ILLINOIS

GET MORE FOR YOUR MONEY FROM HEMPHILL GUARANTEED EQUIPMENT

GUARANTEED GOOD BECAUSE REBUILT AND TESTED BY HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1500	GE	Pyranol	3	4150x2400
2	750	GE	HT	3	4150Yx120/240
1	500	Kuhl	OISC	1	4600x2300
2	400	Pitts.		1	2400/4800x240/480
1	333	GE	OISC	1	13200x220/440
3	333	West	OISC	1	2300/575
1	225	Stand	OISC	1	440x220
1	200	GE	HT	3	2300x220
1	200	Pitts.	ODSC	1	4000x110/220
1	200	Mol.	C	1	2300x220/440
2	200	Al. Ch	OISC	1	480x120/240
2	150	Pitts.	OISC	1	240x120/240
3	100	West		1	13,200/-220/440
3	100	Wagner	HEB	1	240x120/120
1	100	Amer.		1	15000x2300
3	100	GE	Auto	1	4150Y2400Y
3	50	GE	H	1	2400/4800x120/240
9	50	GE	H	1	13750x125x216Y
1	50	Al. Ch.	ODSC	1	13530x120/240
2	50	Pitts.	Sub	1	13530x120/240
1	50	Amer.	OISC	1	6600/13200x220/440
1	50	Amer.	WF	1	240x240/30
1	50	GE	RS	1	2300x230
1	37	GE	H	1	2200x110/220

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
1	150	GE	720	ATI	2300
1	150	GE	1800	TS	220
1	150	Whse.	900		220

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	GE	514	600	2300/4150 Syn.
1	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	220/440 SC
1	100	GE	900	250	2300 Syn.
1	94	GE	1200	60	4150 Syn
1	30	GE	900	230	220 Syn.
2	30	GE	1200	125	440 SC.

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	GE	600	MT	440
3	150	AC	1800		2400
1	100	GE	600	IM	440
1	100	GE	400	IM	440
1	75	GE	500	IM	440

SPECIAL WELDING

1—150 KVA GE, type KWC, 1 ph., 550 V, sec. 12.22/6.05 V, Thryatron Spot and Seam, Control CR 7503

SLIP RING MOTORS—(Con't)

1	75	GE	1200	MT Vert.	220
1	60	GE	1750	MT	220
1	60	GE	900	MT	440
1	50	GE	1720	MT	220
1	50	Whse.	900	CW	220
1	50	GE	1700	MT	220
1	50	GE	600	MT	220
1	40	GE	1200	MT	220

REDUCTION GEAR

1—150.H.P. Terry Reduction, ratio 5.4:1 type XA 435 input 80 output RPM.

SPECIAL M.G., A.C. WELDER

1—176 KVA Whse., 220 V. 57 PF, 1200 RPM, 1 ph., with 75 HP Slip Ring, 440 V, type CW, Exc. & Control w. flywheel.

Member of the National Industrial Service Assn., Inc.

"FOR POWER"
J.L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3727
PHONE NEW JERSEY—UNION 3-2600

A FEW OF OUR *SPECIALS*

TURBO UNITS, Non-Condensing

937 KVA GE 480/240 v. 150/200# & 0/15# bp
375 KVA Al. Chal. 240/480 v. 135/150# & 0/25# bp
125 KVA GE 240/480 v. 135/200# & 0/25# bp

BOILERS

3—45000# BW 275# Integral furnace F19. "1937"
2—30000# Combustion 2 drum, package type, 250# "1949"
1—309 HP Combustion 3 drum, 160# "1940"
1—256 HP Combustion 150#, semi-portable, "1950"
2—255 HP Combustion, 200# 3 drum. "1937"
1—125 HP Erie City, 200# self contained "1947"

DIESEL UNITS

875 KVA Wghse.-DeLaverne, 2300/480/240 v. "1941"
512 KVA GE 2300/480/240 v. Worthington "1945"
125 KVA (2) General Motors, 1200 rpm Model 268A, 480/240 volts; dir. con. Exciters, Switchgear, (New, never operated)

STEAM ENGINE UNITS, A.C.

375 KVA (2) Wghse—Skinner Uniflow
187 KVA Wghse.-Ames Uniflow (vertical)
150 KVA GE-Skinner Uniflow
75 KVA GE-Ames Uniflow

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

SUPERIOR DIESEL GENERATOR SETS

100 KW

30 sets available. ENGINE: 8 cylinder, 150 H.P.—5½ x 7. GENERATOR: 120/240 volts D.C., 417 amps., stabilized shunt, electric starting.

WRITE — WIRE — PHONE

THE BOSTON METALS CO.
313 E. Baltimore Street
Baltimore 2, Md.
Curtis 5050

—TRANSFORMERS—

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries. New Transformers built to your specifications.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes. One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 CINCINNATI 27, OHIO

REFRIGERATION UNITS

TWO PRACTICALLY NEW WORTHINGTON CARBONDALE

REFRIGERATION COMPRESSORS

300 Ton Freon

Ideal for large plant or office building

WILL SACRIFICE

WINSTON MACHINERY CO., INC.
326 WEST OHIO STREET
INDIANAPOLIS, INDIANA

MOTORS • GENERATORS • TRANSFORMERS

7 x 7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Meter—580 H. P. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. D.C. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

55" LIFTING MAGNETS

2—55" Cutler Hammer Magnets 250 Volts DC. Excellent Condition.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP G. E. Type KT 3/60/440/600 RPM.

250 HP G. E. Type KT 3/60/440/720 RPM.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 360/220/440/1800 X-Proof.

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.
Will make 1200 RPM 125 Volt Generators.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

333 KVA TRANSFORMERS

4—333 KVA Gen. Elect. Transformers Type H Form VRW Primary 2400/4800 Secondary 240/480 Single Phase 60 cycle with Taps. Immediate Shipment.

REBUILT TRANSFORMERS

3—100 KVA Pittsburgh 1/60/4800/230/460

3—75 KVA Pittsburgh 1/60/2300/4000Y/230/460

3—50 KVA Moloney 1/60/4800/230/460

3—50 KVA Westinghouse Type S. 1/60/2300/230/460

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy. 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

STEAM TURBINE GENERATOR UNITS
3 Phase, 60 Cycle

2,500 KVA Westinghouse condensing, 200/400 lbs. steam pressure, 700° FTT, 2400 volts, with surface condenser.

1,563 KVA General Electric noncondensing, 250 lbs. steam pressure, 700° FTT, 15 lbs. exhaust, 2300 volts.

UNIFLOW GENERATOR UNIT
3 Phase, 60 Cycle

750 KVA Allis generator, 240/480/600/2300/4160 volts, 277 RPM direct connected to Ames vertical uniflow steam engine, 160-225# pressure, 5# exhaust.

BOILERS

60,000# steam per hour (2) Foster Wheeler, package type marine, 435# pressure. Oil fired.

45,000# steam per hour (3) B. & W., 275# pressure. Pulverized fuel.

30,000# steam per hour (2) Combustion Engineering, package type, 250# pressure. Oil fired.

GENERATORS
3 Phase, 60/240 Cycle

2500 KVA G.E. 60 cycle, 2400/480 volts, 3600 RPM.

2859 KVA (3) G.E. 240 cycle, 4160 volts, 4800 RPM.

4600 KVA G.E. 90 cycle, 2400 volts, 5400 RPM.

GASOLINE GENERATOR UNIT
3 Phase, 60 Cycle

75 KVA G.E. generator, 2300 volts, 1200 RPM direct connected to 100 HP Winton gasoline engine.

INTERNATIONAL POWER MACHINERY COMPANY

Union Commerce Bldg., Cleveland 14, Ohio
Telephone: MAin 1-9514

Anything in ELECTRICAL EQUIPMENT

PARTIAL STOCK LIST — SEND US YOUR INQUIRIES

MOTOR GENERATOR SETS

150 KW Westinghouse 275 V. D.C. 3/60/2300-1200 RPM

150 KW Allis Chalmers 275 V. D.C. 3/60/2300-1200 RPM

ROTARY CONVERTERS

1000 KW, G.E. 600 V, D.C. 900 RPM, 6 PH. Interpole, Type NCC with transformers 13,800 V

4—500 KW WH 600 V. D.C. 1200 RPM, 6 PH. Interpole, Type HCC, with transformers 27,600 V. Automatic switchboards and automatic brush lifters.

SYNCHRONOUS MOTORS 3/60/2300

3—125 HP G.E. Type TS, Form PK, P.F.—1—900 RPM

1—175 HP G.E. Type ATI, Form PB, P.F.—1—450 RPM

1—400 HP W.H. Form IS, P.F. .8—P.B. 900 RPM

6—175 HP W.H. P.F.—1—3600 RPM, 440 V

T.E.F.C. — MOTORS

QTY.	HP	MFG.	FRAME	RPM	TYPE
1	40	Cent.	444	1750	SC
3	30	Armour	445	900	K
1	30	F.M.	405	1800	Q
1	20	Delco	403	900	
10	15	G.E.	326	1800	KGXP
15	5	W.H.	254	1750	CS
17	5	Cent.	284	1150	SCXP
5	3	G.E.	225	1750	KGXP
7	2	G.E.	225	1750	KGXP

MOTORS, GEAR HEAD A.C.

2 HP Link Belt, Size DM30, XP, 3/60/220/440-45 RPM—R.B.

5 HP Link Belt, Size DM30, 3/60/220/440-84 RPM—R.B.

7½ HP W.H. TEFC, 3/60/220/440-580 RPM—R.B.

20 HP Link Belt, Size DM70, 3/60/220/440-74 RPM—R.B.

20 HP W.H. TEFC, 3/60/220/440-194 RPM—R.B.

40 HP G.E. TEFC, 3/60/220/440-581 RPM—R.B.

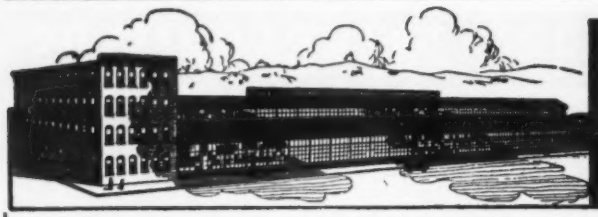
GEAR REDUCERS

3—Falk, Type 11HCP, 200 HP, Ratio 10:1

BUCKEYE *Trading Corporation*

LARGEST STOCK IN MIDWEST

1015 to 1021 PAPIN STREET CHESTNUT 3110 ST. LOUIS 2, MISSOURI



GLOW ELECTRIC CO.

927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

MEMBERS OF AMERICAN REBUILDERS ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	900	4600	Westinghouse
350	3600	2200	Westinghouse
300	1200	2300/440	Westgh., CS
300	900	440	G.E.
200	490	2200	G.E.,-I
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	1200	2300/440	A-C, AR.
100	720	440	Westgh. 3 Brg.
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
50	3600	220/440	G.E.-4049
50	1800	220	Triumph
50	720	2200	Westinghouse
40	1800	220/440	West.-444
40	900	440	G.E.
40	720	440	G.E.
35	3600	220	G.E.-KT
35	600	440	G.E.
30	3600	220/440	Westgh., 364
30	1800	440	GE-KT323
30	720	220	G.E.
30	514	440	Stanley
25	3600	220/440	L-A
25	1800	220/440	A-C, Fr. 365
25	1200	220	A-C, AN
25	900	440	G.E.
25	600	440	G.E.
20	3600	440	A-C
20	1800	220/440	G.E.
20	1800	220/440	G.E.
20*	1800	220/440	Wesehe.
20	1200	220	Westgh., CS
20	900	440	A-C
20	600	220	G.E.
15	3600	220	G.E.
15	1800	220/440	G.E.
15	1200	220	Imperial
15	900	220	Howell

*New Motors

4 SPEED MOTORS AND CONTROL

Century, Model SCNM504Y901AV, 20 HP, 440 volt, 3 Phase, 60 Cycle, 1700/1120/870/560 RPM, Multi-speed, ball bearing. With plugging switch mounted on shaft; motors on adjustable hinge bases. Control —Allen Bradley, Magnetic.

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
400	514	440	West.-CW
375	1800	2300	Al. Ch.
350*	514	440	G.E., TE, FC, BB
300	514	440	Al. Ch. 3 Brg.
250	600	2200	G.E.-117B
250	450	2200	C.-W.
250	450	2200	G.E.-I-17B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.
200	600	440	West.-CW
200	600	440	G.E.-IM
200	514	440	West.-CW
150	1800	2200	FM-HV
150	720	2200	Al. Ch.
150	600	220	Wagner
125	1750	2200	West., CW
120	900	550	Ideal
100	720	440	Al. Ch.
100	600	2200	G.E. MT-562
100	600	220	Wagner
100	400	440	West. Elec. (GE)

*New

MOTOR GENERATOR SETS

D.C. OUTPUT KW	Voltage	Description	A.C. INPUT HP	RPM	Volts
1500	600	G.E., MCF	2100	720	13200
1200	525	Al. Ch.-G.E.	2000	720	2300
800	500	West., 3 unit	1200	1200	2300
800	250	Westgh.	1200	1200	2300
750	550	G.E.	1070	900	2300
750	500	Westgh.	1070	900	13200
750	250	Westgh.	1070	900	13200
600	250	Westgh. (2-300KW Gen.)	1280	1200	2300
600	250	G.E.	900	900	2300
400	250	Westgh.-G.E.	600	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.,-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	730	440
200	250	G.E.,-Westgh.	300	1200	440
100	250	Delco-Westgh.	150	1200	220
100	250	G.E.	150	1200	220/440
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	190	1200	2300
40	250	Westgh.-G.E.	60	1200	220/440
35	125	G.E.	50	1800	2200
22	125	Al. Ch.	33½	900	220
20	115	G.E.-Al. Ch.	30	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440

PLATING AND ANODIZING SETS

D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	HP	A.C. VOLTS	END DESCR.
4000	2 to 8	425	Jantz & Leist			
2400	40/80	1200	Westgh.	290	440	WH Sync.
1500/750	6/12	1200	Munning Loeb	15	440	GE—1 Cage
1200	60	1160	Century	108	220/440	Century, SCN-584
1000	60	1200	Century	100	440	Century Cage
1000	6	1200	Wagner	—	—	—
800	30	900	C-W	40	220	C-W type 122Q
680	11	900	Westgh.	15	440	W.H. BB.
600	50	900	E-M	40	440	A-C
600	30	1200	W-E	30	440	GE
600	30	900	G.E.	25	440	GE
500	40	1200	G.E.	30	440	GE-KT
500	12	1200	Ideal	10	220	GE-KT
500	6		GE Rectifier	—	440	—
416	12	1200	HVW	7½	440	GE-KT
400	40	1800	Hobart	25	220/440	Hobart
208	62	1800	G.E.	20	220/440	GE-KT

ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors—3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
200	1800	GE	SC	K6333S TEFC
200	600	GE	SR 2200 V.	IM-3 Brg.
150	1800	GE	SR	M-6325 TEFC
150	720	Allis-Chal.	SR	AR-Hoist
125	3600	Elliott	SC 2200 V.	9NS02
125	600	GE	Syn.	TS-DC Exciter
100	1800	GE	SR	IM
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.
100	900	GE	Syn. 2200 V.	TS-DC Exciter
100(2)	1200	GE	SC	I-K
75	1200	Wagner	SC	21-W
75	900	AC	SC	AR-BB
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	GE	SC	I-K
60(2)	3600	GE & W	SC	K&CS 4148B
60(3)	1200	Allis-Chal.	SR	ARY-505 BB
60	900	AC	SC 2200 V.	ARZ-TEFC
50	1800	GE	SC	IK
50	1800	FM	SR	HV-BB
50	1200	GE	SR	MT-336
50	900	GE	SC	IK
50	720	CW	SC	SC
50	600	CW	SR	SR
40	3600	GE	SC	K-405a Exp. Pr.
40	1800	GE	SC	KT
40(2)	1200	Rel.&West.	SC	Pr 445-BB
40(2)	1200	FM	SR	HV-BB
40(2)	1200	AC&Rel	SC	TEFC-BB
40	900	West.	SR	CW
30(3)	1800	AC	SC	ARZ TEFC
30	1200	AC	SC	ARZ TEFC
30	1200	CW	SC	SC-BB
25	1200	Howell	SC	KBB-405 TEFC

SPECIALS

3—150 KVA Transformers GE Type H Form KD 1/60 33000 V. pri-2300/6900/11950Y. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 3—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount—Freight allowed. SEND US YOUR INQUIRIES.

NATIONAL ELECTRIC SERVICE CO.

735 So. 4th St., St. Louis 2, Mo. Phone — Chestnut 4603

A.C. MOTORS (3 Ph. 60 Cy.)

HP	MAKE	VOLTS	TYPE	SPD.	WDG.
400	Al. Ch.	2200		514	S.R.
400	G.E.	2200	MT	450	S.R.
300	G.E.	2200/4000	IM	450	S.R.
200	West.	220	CW	600	S.R.
150	G.E.	220/440	ATI	600	Syn.
125	West.	220		277	Syn.
100	G.E.	440	IM	450	S.R.

D.C. MOTORS (250 V.)

HP	MAKE	WDG.	TYPE	SPD.
400	G.E.	Cpd.	MPC	1000
300	Cr. Wh.	Cpd.	CCD	1000
200	Triumph	Cpd.		450
150	G.E.	Cpd.	DLC	800
75	G.E.	Cpd.	RC	600
60	West.	Cpd.	SK	435
20/25	West.	Series	K5	975/875

M-G SETS & ROTARIES

2—500 KW G.E. 1200 RPM 250/125 V. Rotary
400 KW West. 1200 RPM 250/125 V. Rotary
400 KW West. 720 RPM 600 V. Syn. 3/60/2300 v.
300 KW G.E. 1200 RPM 250 V. Syn. 2300/4000 v.
240 KW G.E. 1200 RPM 250 V. Syn. 2300/4000 v.
225 KW G.E. 1200 RPM 125 V. Syn. 2300/4000 v.
150 KW G.E. 1200 RPM 250 V. Syn. 2300/4000 v.
100 KW Rldg. 1200 RPM 250 V. Syn. 2300/4000 v.
75 KW West. 1200 RPM 250 V. Syn. 220/440 v.
35 KW G.E. 1800 RPM 125 V. Sq. Cg. 220/440v.

MOORHEAD ELECT. MACH'Y. CO.

P.O. Box 7991P Pittsburgh 16, Pa.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

FOR IMMEDIATE DELIVERY

TURBO-GENERATORS—Condensing—500 to 20,000 KW; some extraction type, pressures 200 to 450#. *ON WHAT SIZE SHALL WE QUOTE?*
TURBO-GENERATORS—Non-condensing—300 to 3000 KW. 150# to 450#, some extraction with high back pressure. *WHAT SIZE INTERESTS YOU?*
STEAM GENERATORS—30000# to 100000# per hr. 150# to 450#.
BOILERS—Water Tube, Stirling & Straight Tube types 200 to 450#.
Special 2—500 & 1-770 H.P. B&W Co. Stirling Boilers 200#—excellent condition.
BOILERS—Fire Tube, 100 to 300 HP. 100 to 250#. *WHAT BOILERS?*

TRANSFORMERS Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed. Motor-Generators, Rotaries, Frequency Changers, Large Motors & Diesel Generators.

Send us your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

EXISTING

BOILERS

10 to 5000 HP — 10 to 900 PSI

Diesel Engine — Steam Turbine

GENERATORS

DEAN G. STRICKLER & ASSOCIATES

5220 Pennington Ave. 1346 Conn. Ave.
Baltimore 25, Md. Washington 6, D.C.
Curtis 4434 DuPont 7-3386

MOTORS—M. G. SETS—TRANSFORMERS

ENGINEERED AND REBUILT BY EXPERTS IN OUR OWN PLANT

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	6000	G.E.	100	2300	90
1	3000	Whse.	80	4800/2400	720
2	2100	G.E.	100	2300	360
2	1750	G.E.	100	2300	3600
1	750	G.E.	80	2300	450
1	600	G.E.	100	440	360
1	700	G.E.	80	2300	720
1	250	G.E.	100	2300	514
1	200	Whse.	80	440	1200
1	187	G.E.	80	440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550	600
1	120	G.E.	80	550	450
2	135	G.E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900
2	100	Whse.	80	440	1800
1	100	Ideal	80	440	900
2	100	G.E.	80	440	600

With these we can supply—Manual, Semi on full magnetic reduced or full voltage control.

SQUIRREL CAGE MOTORS

3-Phase — 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-806	2300	1200
1	400	G.E.	1-K	2200	¥514
1	400	G.E.	KT-412	2200	450
1	300	Whse.	CS-890	2300	1780
1	200	Whse.	CS-873-C	2200	1200
1	200	Al.Ch.	ARY	440	600
2	125	Al.Ch.	AR	2200	1750
1	125	Al.Ch.	AR	2300	514
1	125	C.W.	126-Q	440	430
2	100	Whse.	CS-663-C	440	1750
1	100	Al.Ch.	AR	550	720
1	100	Whse.	CS-938	2200	514
1	100	F.M.	H-241	440	450
2	75	Al.Ch.	AR	2200	1705
1	78	G.E.	1-K	440	600
1	75	Al.Ch.	AR	2200	720

Special—1 (new) G.E. Vertical KF-574, 2200-Volt 580 R.P.M., enclosed, hollow shaft.

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1(3-U)	2400	Whse.	720	600	2400/4800
2	1500	G.E.	600	600	4150/2300
3	1000	Whse.	514	600	11000/6600
4	1000	G.E.	514	600	11000/6600
1	1000	G.E.	514	600	2300
2	500	C.W.	720	575	2300/440
1	400	C.W.	1200	125/250	440/2300
2	250	Whse.	1200	125/250	2300
1	200	Ridgway	900	275	2300
2	200	Whse.	1200	125/250	440
1	155	G.E.	720	250	2300/440
2	150	Whse.	1200	250	2300
1	100	Al. Ch.	1200	125/250	4000/2300
1	100	Delco	1200	125/250	440/220
1	100	Ridgway	1200	275	4000/2300
1	100	C.W.	1200	125	440/220
1	85	C.W.	1200	250	440/220
1	75	Al. Ch.	900	250	2300
1	75	Whse.	900	75	2300
1	25	Ideal	1750	125	220
1	25	Al. Ch.	1200	250	440/220

We can furnish any of these sets with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt to your requirements.

Motor Generators of modern design, complete with control—still on their original foundations—available for immediate shipment.
(3)—G. E. 1500-KW, 250-VDC, 514 R.P.M., cpd., interpole, pole face windings, 2100-HP syn. motors, .8-PF, 13,200-V, 3-p, 60-cy. will reconnect to 6600-V. or 4160-V.

TRANSFORMERS

Qu.	KVA	Make	Type	Phase	Voltage
3	833	Whse.	OISC	1	66000/59400-2300/4160
1	2750	G.E.	H	3	13,800-2400/4160Y
3	250	Packard	A	1	13,200-2200
3	150	Packard	A	1	2300-230/460
3	100	G.E.	H	1	33,000-2300
3	25	G.E.	H	1	2400-120/240
40(new)	3	Al.Ch.	OISC	1	2400-120/240

SLIP RING MOTORS—CONSTANT DUTY

3-Phase — 60 cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	1800	G.E.	MT 498	2300	357
1	1200	G.E.	MT 26	2200	277
2	1000	Al.Ch.	ANY	2200	235
1	800	G.E.	MT	2200	440
1	700	Whse.	CW	2300	720
1	600	G.E	MT 20	2300	360
1	500	Al.Ch.	ANY	2200	514
2	500	G.E.	I-16-M	2300	450
1	400	G.E.	MT 412	2200	440
1	250	Whse.	CW 937	440	1200
1	250	Al.Ch.	ANY	440	720
1	250	G.E.	MT 414	2200	300
1	125	Whse.	CW 870	2200	900
1	100	Whse.	CW 766	440	1200
1	100	F.M.	H 20 C	440	900
2	100	G.E.	I-15A-M	2300	514

DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	R.P.M.
1***	3000	Whse.	Encl. (Rev.)	600
1***	2400	Whse.	Encl. (Rev.)	600
4***	1500	Whse.	Encl. (Rev.)	600
4***	1200	Whse.	Encl. (Rev.)	600
4***	800	Whse.	Encl. (Rev.)	600
1	350	G.E.	CD-169-A	1150
1	200/250	El. Dy	No. 22	400/1200
1	250	G.E.	MPC	325/975
1***	200	G.E.	MPC	500/1200
1	200	Whse.	Mill	500/1200
1	180	G.E	MPC	400
1***	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
1	90/160	G.E.	MPC	625/1125
1	100	Rel.	1050T	400/1200

All above 230-VDC except where marked***]
***—Pedestal bearing mill design 525/600-VDC.
Rev.—designed for mill reversing service.

T. B. MAC CABE COMPANY.

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

NOW LIQUIDATING

Equipment from Closed Brewery
Marion, Indiana

3—Westinghouse Dry Type Transformers, 100 KVA & 150 KVA.
1—I-R 7x7 Air Compressor, 15 HP motor.
1—Carbondale 10x10 Vert. twin cylinder Ammonia Compressor, 82 ton, 75 HP motor.
1—Taber Fermentation Gas Collector with 8 storage tanks 50 cu. ft., ASME 245# WP.
5—Niagara Spray Cooler and Fan Cooler Units.
1—Rotary Pump 3", with 40 HP motor, 1000 GPM —66' Hd.
Lot of Welded Steel Storage Tanks (closed) 8500 gal., 10,500 gal., 11,300 gal. and 12,700 gal.
Lot of Welded Steel Tanks, 16'10" L x 7'7" W x 8'9" deep, open top, flat bottom.

FOR SALE FROM PHILA. STOCK

2—I-R Meterblowers, type FS-538; cap. 4000 CFM @ 3# Pr.
1—Penn Steam Booster Compressor 4x5
1—Terry Steam Turbine, 10 HP
1—Coppus Steam Turbine, 8 HP
1—Byron Jackson Bronze Deep Well Turbine Pump with 20 HP motor. 150 GPM.
1—I-R #5-ALV Bronze Centrifugal Pump with 40 HP motor. 850 GPM—140'.
1—I-R #1½-RVH Bronze Centrifugal Meterpump with 20 HP motor. 200 GPM—200'.

PERRY EQUIPMENT CORP.
1422 N. 6th St. PHILA. 22, PA.

SLIP RING MOTORS

3 Phase, 60 Cycle

Qn.	HP	Make	Speed	Type	Voltage
4	3500	G.E.	120	IM	2300
1	200	Ideal	1200	Vert.	4000
1	200	G.E.	600	IM	220/440
1	200	Whse.	600	C.W.	220
1	200	G.E.	400	IM	440
1	150	Whse.	1200	HF	2200/4000
1	150	Whse.	900	CI	440
1	150	Whse.	720	C.W.	440
2	100	Whse.	1200	C.W.	440
2	100	A-C	450	ANY	440
1	75	G.E.	900	MT	440
1	75	G.E.	720	IM	220
1	75	A-C	720	3-Bear.	220
1	70	Eng. El.	1200	DP BB	440
1	60	C-W	1800	SR-Vert.	220
1	50	G.E.	900	MT	220/440
1	50	A-C	900		550
1	50	G.E.	600	IM	220
1	40	Whse.	900	C-W	220/440
1	30	G.E.	900	MT	220
1	30	G.E.	900	MT	2200

DIRECT CURRENT EQUIPMENT

Size	Make	Speed	Type	Voltage
325 KW	G.E.	500	MPC 3 Bear.	250
250 KW	G.E.	500	MPC 3 Bear.	250
150 HP	West. El.	1635	RC	230
150 HP	Diehl	25-410	K-15-10-3 Bear.	230
100 KW	G.E.	675	DLC	250
100 HP	Reliance	500	Open-SB	230
65 KW	Whse.	1175	SK-DP-BB	120
40 KW	Reliance	1150	DP BB	250
20 KW	Whse.	825	SK	230
25 HP(2)	Imperial	725	D	230
20 HP	Whse.	1150	SK	230

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle

Qn.	HP	Make	Speed	Type	Voltage
3	200	A-C	900	ART Hi Torque	440
1	200	G.E.	600	IK	220/440
1	150	A-C	900	TEFC AZ	440
1	150	A-C	900	X-PRF, Vert.	440
1	125	Whse.	1200	CS	220
1	100	Wagner	1200	TEFC CI	220/440
6	100	El. Prod.	900	BB	2200
1	75	Whse.	600	CCL	220
1	75	E-M	514	IC	440
1	60	G.E.	1800	K	220/440
1	60	A-C	1200	AR	220/440
1	60	A-C	900	ARV Vert	440
1	60	G.E.	720	IK	440
1	50	G.E.	1800	KT	440
1	50	Master	1800	CFU Vert.	220/440
1	50	El. Dyn.	1800	KNX TEFC	220/440
1	50	El. Dyn.	1800	Open BB	220/440
1	50	G.E.	1800	K	220/440
1	40	U.S.	1800	SA	440
2	40	A-C	1200	AR	220/440
1	40	A-C	1200	TEFC X-PRF	220/440
1	40	F-M	900	Open BB	220
1	40	G.E.	720	KT	440

SYNCHRONOUS MOTORS

3 Phase, 60 Cycle

1	220	G.E.	720	ATI	440
1	125	G.E.	720	ATI	440
1	115	E-M	600		220
1	50	Ideal	1200	SM	220

WM. KECK'S SONS

Electric Motor & Engineering Service

201 N. Bluff Street — Joliet, Illinois

NEW TRANSFORMERS—25 & 50 KVA

GE, OISC, Distribution Type "H", Form KO2, single ph., 50/60 cyc., 33,000 volts primary, 2400/4160 Y secondary, with 4—2½% taps below 33,000 volts, primary cover mounted bushings, secondary tank-wall mounted bushings. S/N 6,900,000.

AMERICAN ELECTRIC & MAINTENANCE CO.
Paramount & 2nd Sts., Springfield, Mass.
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ELECTRICAL CABLE

- For every industrial and power application.
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.
2668 N. Clybourn Ave., Chicago 14, Ill.

1000 KW DIESEL GENERATOR SET

General Electric 3 Ph., 60 Cy., 2300 Volts, 300 RPM. Complete with Starting Equipment & Switchboard. Overhauled. Ready to ship.

ALJON ELECTRIC DIESEL CO.
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STerling 3-6515

SWITCHGEAR • TURBO-GENERATORS • TRANSFORMERS

10,000 KVA TRANSFORMER BANK — **3—3333 KVA 1 Ph. 60 Cy.**
66000 to 33000 and 13200 volts Westinghouse

1800 KVA 3 PHASE TRANSFORMER — **6600 to 440 volts 60 Cy.**

OTHER TRANSFORMERS 1 PH. 60 CY.
2—1000 KVA 13800/2300 V.
3— 200 KVA 33000-2300/4600 V.
7— 100 KVA 33000—2300/4600 V.
3— 75 KVA 2400-240/480 V.
40— 10 KVA 2400-120/240 V.

DIESEL GENERATOR
250 KW Superior YLO 350 HP
400 RPM 3/60/2200-440 or 220

OUTDOOR OIL CIRCUIT BREAKERS
1— 600 A. 110 KV GE FK0136
1— 400 A. 73 KV West. G-1
3— 400 A. 37 KV GE FK0136
1— 400 A. 37 KV West. 0221
1—1200 A. 15 KV GE FHK0236
1— 600 A. 15 KV West. 0221
1— 600 A. 15 KV Condit 0-1

OUTDOOR POTENTIAL TRANSFORMERS
13—33000/110 V. 200 V—A GE E116
3—33000/110 V. Westinghouse

INDOOR OIL CIRCUIT BREAKERS
1—2000 A. 15 KV 500 MKVA West. CO-11
9—1200 A. 15 KV 500 MKVA West. CO-11
1—1200 A. 15 KV 150 MKVA West. B20B
1— 800 A. 15 KV 130 MKVA West. B20
12— 400 A. 15 KV 130 MKVA West. B-20
1—2000 A. 4500 V. GE K-34

Galvanized Steel Substation Structures — Air Break Gang Operated Switches 73 KV, 37 KV & 15 KV — Outdoor & Indoor Disconnects

TURBO-GENERATORS IN STOCK

1—6250 kva 5000 kw 3600 rpm Allis-Chalmers 200 lbs. 100° SH Condensing. Will operate 275 lbs. 615° TT without change. Generator 3/60/11500—can be changed to 2400/4160 V. Complete auxiliaries—can be operated for inspection. Checked by factory engineer in Sept. 1951—no repairs required.

1—1567 kva 1250 kw 3600 rpm Allis-Chalmers 150 lbs. condensing. Will operate 200 lbs. 450° TT without change. Generator 3/60/2300. Complete auxiliaries.

1—1250 kva 1000 kw 3600 rpm Westinghoues 185 lbs. 100° SH condensing 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.

1—937 kva 750 kw 3600 rpm General Electric 150 lbs. condensing. Generator 3/60/2300.

1—187½ kva 150 kw Westinghouse geared 7200/900 rpm 150 lbs. 100° SH non-condensing. Generator 3/60/240.

1—125 kva 100 kw West. geared 7200/900 rpm 150 lbs. non-condensing 3/60/240.

1—1500 kw 3600 rpm 3/60/2300 Gen. Elec. 140 lbs. non-condensing.

1—1000 kw 3600 rpm 3/60/2300 Gen. Elec. 140 lbs. non-condensing.

1—500 kw 3600 rpm GE non-condensing 175 lbs. throttle 3/60/2400.

TAMPA ARMATURE WORKS, INC.
"Industry's Friend"
401 S. MORGAN ST. PHONE 2-1966 TAMPA, FLORIDA

FOR SALE BY OWNER

2000-KW., WESTINGHOUSE NON-CONDENSING TURBO-GENERATOR.

Now Nozzled for 250# psig., 20# Back Pressure, 3/60/2300-V. With Moderate Changes Good for 400# psig., 50# Back Pressure. Condition GOOD. Complete Unit with Direct Connected Exciter, Switchboard, etc. *Immediate Delivery.*

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BOILERS

10 to 1000 H.P.
NEW-USED
RECONDITIONED
Steam, Gas and Electric Power Equipment
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507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

FOR SALE
18 NEW TURBINES
4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

BOILER FEED PUMPS

1—Lecourtenay 675 G.P.M., Type 4M 8B, 5 stage, 1100 Ft. Hd.
1—Worth. 740 G.P.M., type WCS-2, 5", 2250 Ft. Hd.
1—Worth. 700 G.P.M., type UNS-1, 6 stage, 6". 1550 Ft. Hd.
2—I. R. 200 G.P.M., 2", 1375 Ft. Hd.
Pumps above are mounted on basis for motor or turbine drive.

We have about 200 various size cent. pumps on hand, turbine, motor, and gasoline driven. Send us your inq.

DALTON SUPPLY CO.
2829 Cedar St. Phila. 34, Pa.

FOR SALE
DIESEL ENGINES

1—360 HP Busch Sulzer—312 KVA Generator
1—300 HP Vern Severin—with 250 KVA Generator
1—480 HP Fairbanks with 400 KVA Generator
3—360 HP Fairbanks with 300 KVA Generator
3—240 HP Fairbanks with 200 KVA Generator
1—180 HP Fairbanks with 150 KVA Generator
3—120 HP Fairbanks with 90 KVA Generator
1—240 KVA Ames Unaflo Steam Generating unit

All of the above at Bargain Prices

A. C. ASKEW
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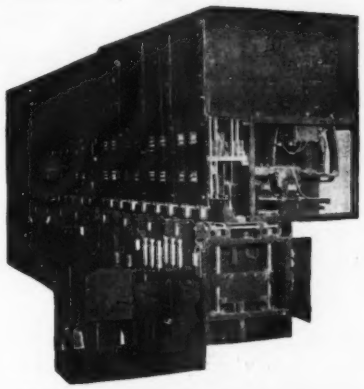
TULSA 8, OKLA.

MODERN AIR COMPRESSORS
1721 FT. INGERSOLL RAND PRE-2—2200 V.
1302 FT. SULLIVAN WN-31—220/440 V.
1302 FT. INGERSOLL RAND Pre-2—2200 V.
676 FT. WORTHINGTON 125 H.P. 220/440 V.
676 FT. WORTHINGTON STEAM 2 STAGE
315 FT. INGERSOLL RAND 75 H.—440 V.
DARIEN, 60 E. 42nd St., N. Y. 17, N. Y.

FOR SALE — PULVERIZERS
One 36" and two 18" pulverizers manufactured by the Bonnot Co., Canton, Ohio. Also screw conveyors, circulating fans, pulverized coal blowers, and hoppers.
KLATZKY BROTHERS, INC.
CALUMET, MICHIGAN

UNDERFEED STOKER
BITUMINOUS 250 H.P. COMBUSTION ENGINEERING — SKELLY TYPE — ALL CONTROLS 240 VOLTS 3 PHASE—NOW IN SERVICE—AVAILABLE IN MAY—REASON—CONVERTING TO OIL.
SHOUP-OWENS INC.
1100 Adams St., Hoboken, N. J.



GENERAL ELECTRIC DRAWOUT OIL CIRCUIT BREAKERS

13—General Electric type MI-9 drawout type Metal Clad Switchgear, each unit containing one FK-143R, 1200 ampere, 7500 volt, 3 pole, 50,000 KVA oil blast oil circuit breaker, solenoid operated, 125 volt DC, complete with control switch, indicating lamps, current and potential transformers.

The above is one complete switchboard but can be divided to suit your needs.

OUTDOOR OIL CIRCUIT BREAKERS
(without oil)

Qu.	Make	Type	Volt	Amp.	Control	Int. Cap.
2	G. E.	FHKO-236-2452-BF73	73,000	600	Motor	500,000
1	G. E.	FHKO-136-2046	73,000	400	Solenoid	350,000
2	G. E.	FKO-136-2046-BS	50,000	40	Solenoid	280,000
1	Condit	KO-40-37-C	37,000	400	Solenoid	750,000
1	G. E.	FHKO-236-1640-BS	37,000	400	Solenoid	500,000
1	G. E.	FHKO-136-2046	37,000	400	Solenoid	500,000
1	G. E.	FKO-136-1026-AS	25,000	400	Manual	125,000
3	Conduit	OI	23,000	400	Manual	60,000
1	G. E.	FKO-139-24-AS	15,000	600	Solenoid	350,000
1	G. E.	FHKO-136-1328-BS	15,000	600	Solenoid	250,000
1	G. E.	FKO-139-24-AS	15,000	1200	Solenoid	350,000

INDOOR OIL CIRCUIT BREAKERS

Qu.	Make	Type	Amps.	Volts	Poles	Int. Cap.
19	Condit	E-4	800	7500	3	18,000— 2 min
7	G. E.	FK-35	400	600	3	25,000— 2 min
1	G. E.	FK-25	5000	600	3	30,000— 2 min
14	G. E.	FK-132A	400	15KV	3	40,000— 2 min
13	Westg.	B-2	600	15KV	3	40,000— 2 min
4	G. E.	FK-132A	1200	7500	3	40,000— 2 min
7	Westg.	B-2	1200	7500	3	40,000— 2 min
4	Westg.	B-2	1500	7500	3	40,000— 2 min
1	G. E.	FK-34A	2000	4500	3	50,000— 2 min
11	G. E.	FKR-132B	400	15KV	3	65,000— 2 min
7	Westg.	B-13	600	15KV	3	65,000— 2 min
11	Westg.	B-13	1200	15KV	3	65,000— 2 min
2	G. E.	FK-44B	2000	5000	3	100,000—15 sec
4	Westg.	B-26	1600	7500	3	250,000— 2 min
2	A. C.	DZ-100	2000	15KV	3	250,000— 2 min
2	G. E.	FK-255B	2000	15KV	3	250,000—15 sec
1	Westg.	CO-111	1200	15KV	3	500,000— 2 min

NEW AND RECONDITIONED SWITCHGEAR

JOSEPH P. MANYPENNY CO.

PHONE DE 6-3300

1667 MEADOW ST. **PHILADELPHIA 24, PA.**

---

4 B&W BOILERS

WATER TUBE—ASME CODE

From ATR Tug

Built 1943

15,000 lbs. steam/hr./unit—normal

18,000 lbs. steam/hr./unit—max.

Design Pressure—268 lbs./sq. in.

Temp., degree Fahrenheit

Total steam at drum outlet (saturated) . . . 409

Forced draft—turbine driven blowers

Boiler heating surface . . . 1508 sq. ft.

Fuel . . . oil or gas

FOR DETAILED INFORMATION

WRITE — WIRE — PHONE

THE BOSTON METALS CO.

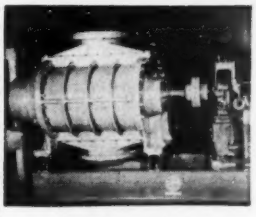
313 E. Baltimore Street

Baltimore 2, Md.

Curtis 5050

THE NATION'S

Exclusive Specialists in Rebuilding BLOWERS · FANS · EXHAUSTERS



Sutorbilt Blower—Rebuilt and Ready for Shipment

Fully Guaranteed
We Feature Leading Makes
IMMEDIATE DELIVERY

Here is the *"largest stock in the world"* of blowers, fans, and exhausters—both new and rebuilt. Our 27 years' experience and factory-trained men assure you of the best in air-moving equipment. A partial listing is shown . . . write for our detailed list.

ROTARY-POSITIVE BLOWERS

Press. Max.	Cap. Max.	Make
10	215	Roots-Con.
10	128	Sutorbilt
6	5500	Roots-Con.
6	76	Sutorbilt
5	2130	Roots-Con.
3	650	Roots-Con.
3	366	Roots-Con.
3	124	Roots-Con.
3	69	Sutorbilt

80 others in stock.

TURBO BLOWERS

Volume c. f. m.	Static- oz.	Make
410	96	Allen-Billmyre
225	96	Allen-Billmyre
3700	32	N. American
3800	24	Spencer
10400	20	Ingersoll Rand
1500	16	Spencer
1100	16	N. American
1075	16	Spencer
1000	16	Spencer
100	16	Gen. Blower

60 others in stock.

CENTRIFUGAL FANS

Size	Type	Make
49	ME	New York
3¼	W	Clarage
8	I	Bayley
7	B/C	Bayley
6	LL	Buffalo
85	5V	Sturtevant
5½	HS	American
4	LL	Buffalo
1¾	W	Clarage
3½	AHS	American
4	M	Garden City

200 others in stock.

STEEL PLATE EXHAUSTERS

Size	Type	Make
80	SS	Alington-Cur.
70	ME	Sturtevant
50	SS	Buffalo
23	IE	Clarage
55	E	American
55	Des. 1	Sturtevant
30	SP	Garden City
40	SP	Buffalo
15	IE	Clarage
35	SP	Garden City

110 others in stock.

WM. W. MEYER & SONS, INC.

8243 ELMWOOD AVE., SKOKIE, ILL.

Chicago Suburb — Chicago Telephone — KEystone 9-8260

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
600	2200	Whse.	450
500	2200/4000	G.E.	900
450	440	Whse.	514
300	2200/440	Whse. (new)	600
300	2200	G.E.	360
300	440	Whse.	3600
250	4000/2300	G.E.	450
250	440/220	Whse.	600
250	550/440	G.E.	1200
250	440	G.E.	600
200	440/220	Whse.	514
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	2200/440	G.E.	600
150	550/220	G.E.	720
145	4000/2300	G.E.	1800
125	550/440	G.E.	1200
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	2200/440	G.E.	ATI	720
300	2300/400	G.E.	TS	720
300	2300/440	G.E.	TS	720
250	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
240	2300/440	G E	ATI	720
225	440/220	Whse.	HR	360
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	G.E. (25 cy.)	TS	375
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator dir. conn. to 50 hp. G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E., 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
1—400 amp., 7500 V., G.E., outdoor, new

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	2200	G.E.	PT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
350	2300	G.E.	KT	1200
300	2200	L. Allis	FS	1800
300	2200	G.E.	PT	3600
250	2200/440	G.E.	IK	720
225 (2)	2200/440	G.E.	KT	1200
200	2200/440	G.E.	K	1200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	IK	600
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G.E.	IK	450
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150	440/2200	G.E.	IK	514
150	2200/440	G.E.	KT	600
125	440/220	G.E.	KT(vert.)	1200
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/410 v., G.E.
1—187 kva, 1200 rpm, 2200/440 V., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
150	230	G.E.	CD	1750
150	230	Whse.	SK	850
120	230	Whse.	SK	350/1050
100	230	El. Dyn.	30-3	475/1250
100	230	Cr. Wh.	CMC	625
90	230	G.E.	CD	1750
80	230	G.E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G.E.	220/440	Syn.	230
150	Whse.	440	sq.ca.	250
100	Al. Ch.	2,00/440	sq.ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G.E.	2200/440	syn.	125
65	G.E.	2200/440	sq.ca.	250
65	G.E.	2200/440	sq.ca.	125
60	G.E.	440/220	sq.ca.	250/125
45	G.E.	440/220	sq.ca.	250
40	G.E.	440/220	sq.ca.	250/125

TRANSFORMERS 60 CY.

3— 500 kva, Whse., 24000—2300 V.
1— 300 kva, Al. Chal. 4800/4160—240/120 V., 3 phase
3— 200 kva, G.E., 11000—2300 V.
3— 200 kva, G.E., 4150—480/240 V.
3— 150 kva, G.E., 23000—2300/4600 V.
3— 150 kva, Al. Chal., 2400—240/480 V.
3— 150 kva, Al. Chal., 2400-240/120 V.
3— 100 kva, Whse., 2400-240/480 V.
6— 100 kva, Whse., 2400—120/240 V.
3— 100 kva, G.E., 4156—120/240 V.
2— 100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 50 kva, Whse., 440—220/110 V., dry
6— 50 kva., G.E., 2400—120/240 V.
11—50 kva, Whse., 2300-110/220 V., dry

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. — HOBOKEN, N. J.

STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Elesco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.
1—705 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Induced Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.
2—8000 HP Webster Water Heaters.
1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.
6—Steel Coal Bunkers, 80 tons each.
1—30" Wheeler Single Stage Circulating Pump, 35,000 GPM direct connected to 300 HP Allis-Chalmers Motor, 3/25/440, 360 RPM. (Has extra impeller for 15,000 GPM)
1—4"x6" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam turbine.
1—100 KW General Electric 125 Volt DC Generator direct connected to a General Electric-Curtis Steam Turbine, 2-stage with reduction gear. Type SO, 3000 to 1200 RPM.
1—Type 1A-60 Wheeler Turbo Air Pump direct connected to 75 HP General Electric-Curtis 2-Stage Steam Turbine, 1750 RPM.
1—6" Wheeler Centrifugal Condensate Pump direct connected to a 20 HP General Electric-Curtis 2-Stage Steam Turbine, 1800 RPM.
1—Combination Circulating Pump and Condensate Pump driven by 190 HP General Electric single Stage Steam Turbine through a Westinghouse Reduction Gear, 3500 to 700 RPM.
1—2" 2-stage LeCourtney Centrifugal Pump, 200 GPM 650' Head at 3700 RPM direct connected to 53 HP Westinghouse Steam Turbine.
1—3000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 250 RPM, 600 Volts DC with 1—3150 KVA General Electric Transformer, 3 phase, 25 cycle, 6600/13200-445 Volts with starting panel and all instruments.
1—1000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 750 RPM 600 Volts DC with 1-1050 KVA General Electric Transformer, 3 phase, 25 cycle, 13200/445 volts with starting panel and instruments.
1—500 KW Westinghouse Synchronous Converter, 6 phase, 60 cycle, 1200 RPM, 600 Volts DC with starting panel and instruments.
1—4000 KVA Westinghouse Transformer, 3 phase, 25 cycle, 7200/6600 volts.
7—700 KVA Westinghouse Transformers, single phase, 25 cycle, 7620/6600 volts to 13200 volts.
1—Kennecott Pressure Type industrial Water Filter.
1—50-Ton Electric Traveling Crane—55'5½" Span.

Send for Complete Inventory

MORSE BROS. MACHINERY COMPANY

2900 BRIGHTON BLVD.

P.O. Box 1708, DENVER, COLORADO

POWER PLANT SPECIALS

1—100,000 lb. pr. hr. B.&W. Sterling type Boiler, 450#, complete with all auxiliaries.
1—16,000 lb. pr. hr. B.&W.—FF, 160#. Complete with oil burner, controls, etc.
2—30,000 lb. pr. hr. Combustion Engineering Boilers, 250#. Complete with all auxiliaries, oil fired.
1—300 HP Pacific low pressure Boiler, oil fired.
COMPLETE DIESEL ENGINE PLANT consisting of 3—Mackintosh & Seymour Diesel Engines, 660 HP at 300 r.p.m. solid injection driving 3 Gen. Elec. 625 KVA generators 3/60/2300 V. (will reconnect to 480 V.) Complete plant with switchboard, centrifuges, pumps, tanks, etc.—Also Turbo Generators, Transformers, Motor Generators.

We buy entire power plants. What have you to offer?

HOWE BROTHERS

342 MADISON AVENUE
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FOR SALE

BOILERS & HEATING EQUIPMENT

Three 4-drum Sterling boilers, approximately 45 HP ea., Bros stokers, feed pumps, pre-heaters, coal conveyors, ash removing machinery, etc. Many Fisher steam pressure regulators, extensive steam mains, expansion joints, several smaller boilers. All on railroad siding.

VETERANS' VILLAGE, INC.

Buckley Field, Denver 8, Colorado

300 K.W., A.C. Diesel Plants
250 K.W., D.C. Diesel Plants
New equipment @ ½ price—no dealers—
Two D.C. units available, Hendy D56E engines, 450 R.P.M. Crocker Wheeler Generators 120/240 V—Will convert to 300 K.W., A.C., 514 R.P.M., any voltage—complete with Switchgear and accessories.

Electrical Construction Corp.
246 Border St., East Boston 28, Mass.
Liberty 2-9200

750 KW 3/60 SKINNER UNIFLOW STEAM ENGINE GENERATOR SET

150 pounds—2 pounds back pressure. Excellent condition, scarcely used. Can be demonstrated in operation on original foundations — ridiculously low price for quick sale as space is urgently required.

SOUL CLINIC INC.
CALGARY, ALBERTA, CANADA

FOR SALE
Unused G.E. 1750 H.P. Motor

3600 RPM, squirrel cage induction, complete with starting switchgear.

PITTSBURGH CONSOLIDATION COAL CO.
Research and Development Division
LIBRARY, PENNSYLVANIA

$2.95 EACH OR 2 FOR $5.00!

Upright Telephone complete with cord in Tested and Guaranteed condition. For Intercommunication or extension. Complete list of telephone parts, inter-communication sets, switchboards, handsets, magneto and dial telephones, etc. Write for list. F.O.B. Simpson, Pa. C.O.D. Shipments accepted.

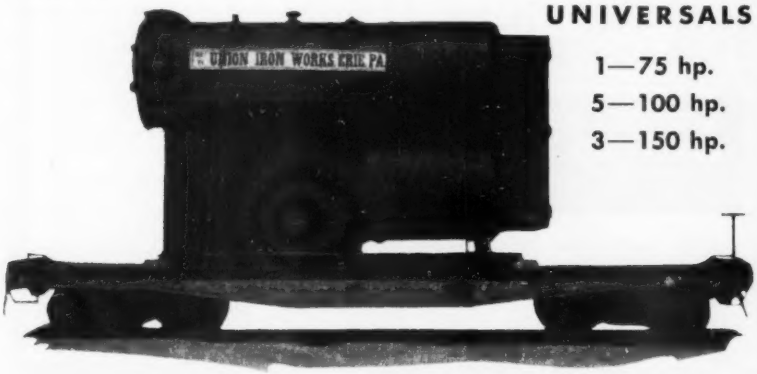
TELEPHONE ENGINEERING CO.
DEPT. 10 SIMPSON, PA.

Watch—
the *Searchlight Section*
for
Equipment Opportunities

New BOILERS *for Sale...*

Reduced Prices . . . Quick Delivery

These are new Union Boilers from stock—need only to be fitted and painted. They are for 150 p.s.i. maximum. Prices are reduced for quick sale. Save time and money—first come first served. They are all factory assembled units complete with furnace brickwork.—Write, telephone or wire for details.



UNIVERSALS

1—75 hp.
5—100 hp.
3—150 hp.

LITTLE GIANTS

6—15 hp. 3—35 hp.
2—20 hp. 2—40 hp.
3—25 hp. 4—50 hp.
4—30 hp. 6—60 hp.
1—80 hp.

UNION IRON WORKS

ERIE, PA.

TELEPHONE ERIE — 2-3601
WRITE BOX 896A—ERIE, PA.

1—500 KW TURBO GENERATOR

General Electric, AC, 2300/480 volts, 3600 RPM, Rigid frame. Steam Turbine, 125/150# steam pressure, direct connected Exciter and Surface Condenser.

SUNDFELT EQUIPMENT COMPANY, INC.
220 Hudson St. Seattle 4, Wash.
LAnder 9311

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25 CYCLE MOTORS—1 to 125 HP—Try Us
2—72 Ton Ref. Compressors w/75 HP Mtrs.
2—100 HP Mtrs. 1200 & 1800 RPM Complete
1—5500 GPM 12x12 NEW Centrifugal Pump
1—1000 & 700 HP Diesels w/Generators
1—500 HP Sli Rg. Motor—900 RPM
1—500 & 600 HP direct current Mts.

H. & P., 6719 Etzel Ave., St. Louis 14, Mo.

SURPLUS Boilers

Diesel • Electrics
Turbo Generators • Transformers
Motors

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., N. Y. 33, N. Y.

DIESEL ENGINES & GENERATING SETS

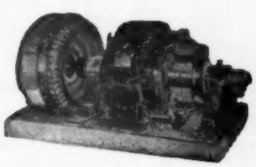
2—Hamilton 1600 HP 720 RPM Dir. Rev. G.M. 500 HP 1200 RPM 8-268A Marine.
4—General Motors Twins, Internally New
10—General Motors Quads, Navy Re-processed
2—Hercules DWXD W/Heat Ex & Clutch
Buckeye W/100 KW Elliot 3/60/240 V./400
Winton W/100 KW G.E. 3/60/450 V.1200
Superior W/100 KW Delco DC 120-240 V.1200
2—Cummins W/90 KW West. 3/60/240 V.1800
7—G.M. W/75 KVA West. 3/60/240 V.1800
Buda W/60 KW Century DC 120 Volt/1350
Cat. W/50 KW Louis Allis 3/60/220-110 V./900
2—Blackstone W/56 KVA Star 3/60/208-120 V./1200
Cummins W/40 KW West. DC 120-240 V.1200
7—Buda W/37.5 KVA Cen 3/60/220-110 V.1800
Int. Harvester W/37.5 KVA Century 3/60/220-110 V./1200 RPM
1—Cummins W/25 KW G.E. AC 1/60/115-230 V./1200 RPM
1—Int. Harvester W/15 KW Century 3/60/120-208 V./1200 RPM
1—Caterpillar W/15 KW Louis Allis 3/60/120-208 V./1200 RPM
2—Waukesha Hesselman W/15 KW Century 3/60/120-208 V./1200 RPM

Partial Listing—Your Inquiries Will Receive Prompt Attention

ALBERT HELLER CO.
210 Snediker Ave., B'klyn 7, N. Y.
HYacinth 5-0800

LATE TYPE
MOTOR — GENERATOR SET

500 KW, 240 volt D.C., 900 RPM. Westinghouse Compound Wound. Serial No. 4979932. 714 HP. Syn. Motor 3/60/2200 volt, 80% P.F. Serial No. 4979926. With Mag. Reduced Voltage Starter. Factory Built Set.



MECHANICAL SPEC.

Base: 125¼" long and 59" wide
Overall Height: 60¾"
Weight: 21,600 lbs.

BENSON-WILIMZIG, INC.
1708 North Eighth St., St. Louis 6, Mo.
Phone Garfield 4290

SPECIAL TRANSFORMERS—YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

FOR SALE

AMMONIA COMPRESSOR

De La Vergne Diesel driven Ammonia Compressor. Engine 5 cylinder, 400 HP, 15 in. bore, 18 in. stroke, solid injection 300 RPM. Compressor (DM6 Unit) 3 cylinders, capacity 75 tons each, 11½ in. bore, 18 in. stroke single acting. This engine is constructed so it can easily be converted to an 8 cylinder engine and has an extension shaft for an auxiliary flat or V belt drive.

Chr. HEURICH BREWING CO.
26th & D Streets, N. W.
Washington 7, D. C.

FOR SALE

150 K.W., 220 A.C.—125 V.D.C., 1200 R.P.M., G.E.—M.G. Set, A.C. and D.C. Panels.
4000 Ampere D.C. Switchboard.
2—2000 Ampere Generator and 4 Feeder Panels. Condition excellent.

OHIO VALLEY GENERAL HOSPITAL
Wheeling, West Virginia

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

BOSWICK ELECTRIC CO.

AIR CIRCUIT BREAKERS

6—1200 ampere, 3P 2T, 600 volt, I-T-E air circuit breakers.

CRADLE TYPE DYNAMOMETERS

1—225 HP Whse., 250 V., D. C., 300/2000 RPM, complete with Toledo automatic printing type scale.
1—150 HP Whse., 275 V. D.C., 3000/5000 RPM, Frame 121, complete with all necessary control.

MOTORS NEW D.C.

230 Volts—Drip Proof

Qu	HP	RPM	Mfg.	Frame
1	5	850/1700	G.E.	CD-66
3	7½	575/1750	G.E.	CD-77
1	7½	1750	Rel(TE)	14T
1	10	300/1200	L.A.	5822

REBUILT D.C. 230 VOLTS

HP	RPM	Mfg.	Brgs.
100	450/1350	Whse.	SI.
50	200/800	E-D	Ball
50	300/900	G.E.	SI.
50	400/1200	Rel.	SI.
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S. SI.
30	350/1050	Whse.	SI.
30	500/1500	Rel.	Ball
25	300/1200	Rel.	Ball
25	500/1500	C-W	Ball
25	600/1350	Rel.	Ball
20	250/1000	West.	SI.

150 Motors 5 to 150 HP.

SLIP RING

HP	RPM	Volts	Mfg.
400	300	2300	G.E.
350	450	2300	Whse.
100	1160	440	G.E.
100	1800	440	G.E.
40	900	220	G.E.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
1400	1200	450	West.	100%
720	900	2300	West.	100%
200	200	440	G.E.	80%
200	1800	440	West.	100%
150	600	440	G.E.	100%
150	720	2200	G.E.	80%
150	900	220	G.E.	100%

A.C. CONTROLS

1—500 HP, 4600-3-60, G.E. CR-1034, man. red volt. starter.
1—150 HP, 2200-3-60 Roller Smith mag. red. volt. starter, auto-transformer type.
1—100 HP, 440-3-60 G.E. CR-7022Y1 wound rotor controller.
2—Size 5 G.E. magnetic starters, 220 or 440 v., NEMA 1 encl.

D.C. CONTROLS

230 volts

1—125 HP Clark magnetic adjustable speed starter.
1—New 100 HP Monitor magnetic, adj. speed starter.
1—Westinghouse 75 HP, reversing, dynamic braking starter.
3—75 HP Cutler-Hammer plain magnetic starter, NEMA 4 encl.
1—50 HP Ward Leonard mag. adj. speed starter, dyn. braking.
1—New G.E. 30 HP variable voltage controller CR 3270Y1, reversing, dynamic braking.
1—30 HP G.E. Planer Control CR 4630Y1, reversing dyn. braking.
(We can assemble any type D.C. control to your specifications)

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO
Telephone—WAlbridge 8-1195

AMERICAN 50 Years' Record Guarantees Satisfaction

COMPRESSORS

NEW AMERICAN AF—Single & two stage—electric etc. Rebuilts—standard makes & sizes—stationary or portable. Rented—gas—diesel—electric—steam. Rebuild or convert your compressor. Trade or buy your compressor.

PORTABLES

60 CFM	Worthington (Gas) 2 PNEU
70 CFM	Smith (Gas) 2 PNEU
105 CFM	Worthington & Ingersoll
160 CFM	Worthington (Gas) 2 & 4 PNEU
210 CFM	Worthington (Gas & Diesel)
315 CFM	IR & Worthington (Gas & Diesel)
500 CFM	Worthington (Diesel) 4 PNEU
600 CFM	Worthington (Diesel) 4 PNEU

STATIONARY

CFM	PSI	SIZE	MANUFACTURER
44	150	5x5	Ingersoll ER-1
66	110	6x5	Penn-IR
69	125	6x6	Ingersoll ER-1
88	60	7x5	IR-Penn
93	100	7x6	American-IR
122	100	7x7	Worthington-IR
136	125	8x8	American-IR
166	135	8x9	IR-Worthington
211	100	9x9	Worthington HB
254	125	10x10	Chicago Pneu.
298	125	10½x11	American AF-1
311	40	12x8	CPT-Penn-IR
364	20	12x7	Worthington-IR
368	100	12x10	IR-CPT
379	40	12x9	Worthington HB
386	115	12x12	Ingersoll ER-1
460	125	12x13	American
503	60	14x10	IR-Sullivan
528	100	14x12	CPT-IR
628	100	14x13	Ingersoll
740	40	17x10	CPT-IR
780	55	17x12	Ingersoll ER-1
868	125	17/10x12	Chicago Pneu.
931	55	17x13	Worthington
1084	30	20x12	IR-CPT
1180	125	18/11x10	Chicago
1292	35	20x13	Worthington
1967	12	26x13	Worthington

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COMPRESSOR REBUILDER
Since 1902

From Our Stock of Over 200 Compressors, Stationary and Portable, We Will Have a Unit for Your Requirements.

AMERICAN AIR COMPRESSOR CORP.

Dell Ave. & 47th St., North Bergen, N.J. · Union 5-4848

FOR SALE

250 HP Bruce MacBeth Gas Engine, 4 cylinder, 250 RPM, direct connected to 152 KW 240 Volt Generator V-belted exciter, control panel with voltage and ampere meters and rheostat.

150 HP Bruce MacBeth Gas Engine, 4 cylinder, 277 RPM, direct connected to 160 KW 230 Volt Generator, V-belted exciter, control panel with voltage and ampere meters and rheostat.

160 HP Sterling Gas Engine, 8 cylinder (Dolphin Marine) rated at 350 HP (on gasoline), 900 RPM, direct connected to 125 KVA 250 Volt Generator and exciter.

ARTIFICIAL ICE & COLD STORAGE CO.
BILLINGS, MONTANA

EQUIPMENT FOR SALE

2—Pa. Air Compressors A1 Cond. (1949 Mfg.) 10"x7" stroke 252 CFM. 40# Press. 25 HP. 440 V. 3 P. 60 Cy. V Belt drives, Starters $600.00 each.
2—Ames Amm. Condensors, Valves. 30" x 16 ft. —109—2" tubes 250# ASME 350° F new 1949. $500.00 each.
Two Frick Vertiflow Brine Cooler Coils 1200 sq. ft. each. $450.00 each.
Four Vertical brine agitators with 3 HP motors 440 V—3 P—60 Cy. V Belt drives $100.00 each.

All F.O.B. South Bend. Ind.

POWER ENGINEER
915½ W. La Salle Avenue
South Bend, Ind.

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450 KVA—3-60-13200-115/230 V. substation.
1000 KVA—3-60-13800-240/460 V. substation.
700 & 450 HP—180 rpm—4160-3-60 UNUSED Syn motors.
3—600 A.—15 kv GE metalclad Swgr. units.
3—500 KVA—3-60-13800-240/480 V. Transformers.
1—37½ KVA 240/480 V,—3-60 Caterpillar Diesel set.

H. BLANE JOHNSON & ASSOCIATES
53 W. JACKSON BLVD., CHICAGO 4, ILL.

1500 KW WEST. RECTIFIER

MERCURY ARC, "IGNITRON", Single Tank, 1500V. DC, Complete Automatic Railway Sub Station, 44,000 V. Delta Primary on Transformer, Installed "NEW IN 1941", Excellent Condition, Located on The P&N Ry. Co. Line, Startex, S. C., LOW PRICED.

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125 HP Whiton BKS
400# 15# BP—3600 RPM

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If there is anything you want
or something you don't want that readers can supply—or use—advertise it in the
Searchlight Section

1—400 H.P. Keeler C.P. Integral Type Watertube Boiler with complete Todd Oil Burner Installation. Design Pressure 160#. Built 1940.

2—500 HP Cleaver-Brooks, 150# pressure. No. 6 oil, complete with pumps and receiver. All trim.

2—500 H.P. B&W 200# w.p. Longitudinal Sectional Header Boilers. Retubed 1952. Location Massachusetts.

1—300 H.P. Titusville Scotch Marine, 125# w.p. Fully automatic, No. 6 oil, Todd Rotary Burner.

1—490 HP Walsh-Weidner sec. Hdr. Cross Drum. 450 lbs. Superheater, etc.

1—250 H.P. Johnson Scotch Marine Boiler, 150# W.P., New in 1950. Fully automatic. No. 6 oil. With all auxiliaries.

1—200 H.P. Bigelow Scotch Marine, 150# w.p. Fully automatic, Ray Burner, No. 6 oil, 1940.

2—854 HP Springfield Sec. Hdr. 225 lbs. Superheaters, etc.

2—250 HP Erie City—3 Drum lowhead. 200 lbs. —a complete Plant 1946. 200# w.p. fully automatic mechanical Peabody burning equipment. 1—Pratt-Daniels Stacks, pumps and heaters.

1—310 HP Keeler "CP" Self-Contained. 160 lbs. With or without STOKERS. Complete Plant.

1—Babcock & Wilcox FF-15 Self-contained. 160 lbs. Complete Plant—16,000 lb. each.

2—750 HP B&W Sterling, 1925, 225# w.p.

1—125 H.P. Erie City Economic, 125# pressure. Complete with stack and trim. 1946.

1—125 H.P. Cleaver-Brooks, 125# w.p., No. 5 oil, 1946, pump, receiver and breeching.

1—80 H.P. Erie City Economic, 125# w.p. Ray Oil Burner, fully automatic, return system and stack. No. 6 oil, 1940.

1—30 H.P. Titusville, 125# w.p. 1947. No. 2 oil.

1—25 H.P. Bessler, 450# w.p. No. 2 oil, 1944.

1—30 H.P. Cleaver Brooks Package 125# w.p. No. 2 oil, 1950.

1—10 HP Titusville Wee Scot, 125# w.p. Light oil, 1946.

Miscellaneous Scotch Marine Boilers, 75 to 150 H.P. available.

A Number of Self-Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.

2—Detroit Roto-Spreader Stokers for 300 H.P. Boilers, nominal rating.

Combustion Engrg., Spreader Stoker complete with fan & Hogan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.

3—Elliot Surface Condensers, 1—900 sq. ft., 2—600 sq. ft. Located in New Jersey.

1—750 K.W. and 1—500 K.W. DC 240 V Generators dir. conn. to 2—Westinghouse non-cond. Turbines—3600 r.p.m. reduced to 900 r.p.m. on generators. Includes switchboards.

1—300 K.W. Gen. Elec. Turbo-generator set. Completely rebuilt and rewound for 220/440 V. Meludes switchboard and exciter. Presently boxed for export. Offered at an extremely low price.

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342 Madison Avenue, New York, N.Y.

Telephone MUrray Hill 2-9098

LAND'S 44th YEAR

MOTORS & GENERATORS, etc.

1 YEAR GUARANTEE

GENERATORS—250 V. D.C. Motor Driven

KW	Make	Type	Speed
1000	Al. Ch.		720
250	Cr. Wh.	CCD	1200
200	West (2)	SK-18	1200
150	West.	SK	900
125	G. E. (2)	MPC	1200
125	El. Dy.	20L	1750
100	Delco (4)		1150
75	Cr. Wh.	51H	1150
50	Cr. Wh.	HH	1150
40	West.	SK	1750
35	G. E.	RC	1750
35	Al. Ch. (4)	3 wire	1750
25	G. E.	CS	1200
15	Star		1750
7½	West.	SK-43	1750
5	West.	SK-284	1750
5	Rel.	T-23T	1750
3	Rel.	T-14T	1740

GENERATORS—Low Voltage D.C.

Amp.	Make	Voltage
10,000	H-V-W	6
10,000	J-L	10
6000	El. Prod.	18/36
5000	H-V-W	6/12
4000	North.	7½
3000	Chandey.	12
2500	Chandey.	6/12
1500	H. V. W.	6/12
750	H-V-W-	6/12
1000	G. E.	15
1000	G. E.	25
1000	West.	24
100	Diehl	32
200	West.	35
200	Burke	35
125	Diehl	40
500	G. E.	32
1500	Century	45
3200	G. E.	50
325	West.	50
1000	G. E.	75

230 V. D.C. MOTORS

H.P.	Make	Type	Speed
250/200	Rel.	2600T	400/800
150	West.	SK	1150
150	West.	Sk	850
125	Rel.	T	600
125/50	E. D.	20-SL	1750 1315
100	West. (4)	SK	1150
100	West. (6)	Sk	850
100	Rel.	651-T	850
100	G. E.	RC	600
100	Rel.	1060T	500
100	A-C		1150
100	FM	TRC-38	725
110/55	G. E.	DMC	800/400
90/45	G. E. (2)	RF-17	950/475
75	G. E.	CD-155	1150
75	West. (6)	SK	1150
75	G. E.	RC	1000
75	Rel.	461-T	850
75	West. (2)	SK	850
75	West.	SK	475
75	Cr. Wh.	CMC-125H	375/950
60	West.	SK	850
60	West.	SK-160	680
60	West.	SK	250/1000
50	Cr. Wh.	CMC-FH	1750
50	G. E.	CD-93	3600
50	West.	SK-160	565
50	G. E.	RF-17	250/1000
40	G. E. (3)	CD-105	850
40	Cr. Wh.	FH	1750
40	West (5)	SK	775
35	E-D	258	350/1050
35	West.	SK	250/1050
35	West	SK	1150

SLIPRING MOTORS

H.P.	Make	Type	Speed
600	Cr. Wh.	131-AQ	507
500	G. E. (2)	IM	450
200	G. E.	MT-559Y	1175
150	G. E.	IM	870
125	West.	CW	1750
125	G. E.	IM	580
100	G. E.	MT347	1150
100	G. E.	IM	690

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
250	GE(TENV)	K-6335	1750
200	Wagner	RP2-26Z	1800
200	West.		1750
200	A. Ch.	AR	865
200	G. E.	KF-6335	880
150	West.	CS	1175
150	G. E.	IK	580
125	A. Ch. (2)	53R	3500
125	A. Ch. (5)	AR	1890
125	Century		3500
125	A. Ch.		690
100	West.	CS607S	3540
100	West.	CS	870

Partial Listing Only!

Please Send Us Your Inquiries

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Established 1910

156 GRAND STREET, NEW YORK 13, N. Y.

CAnal 6-6976

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.
300	G.E.	I-M	1200	S.B.
200	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1800	S.B.
100	G.E.	MT-300	1800	S.B.
100	G.E.	I-M	900	S.B.
100	G.E.	I-M	720	S.B.
75	G.E.	MT-343	1200	S.B.
75	G.E.	I-M	900	S.B.
75	West.	CW	720	S.B.
75	G.E.	I-M	720	S.B.
60	G.E.	MT-333	1800	S.B.
40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-607S	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBBused
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	K-594S	1800	TEFCBBXP
60	G.E.	OG-44	1800	TEFCBBXP
60	L.A.	QS-444	1800	B. B. open
60	F.M.	FB-404	3600	B. B. open
50	Master	K-445	1800	TEFCBBXP
50	G.E.	K-405	1800	TEFCBB
50	G.E.	CS-445	1200	S. B. drip
50	West.	K-505	900	S. B. open
50	G.E.	AR-444	3600	TEFCBBXP
40	A.C.	KF-365S	3600	TEFCBBXP
40	G.E.	CS-405	1800	B. B. Splash
40	West.	K-405	1800	TEFCBB
40	L.A.	404	1800	TEFCBBXP
40	G.E.	CS-504S	1800	B. B. open

REBUILT SQUIRREL CAGE MOTORS

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S. B. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM. We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER

EQUIPMENT COMPANY

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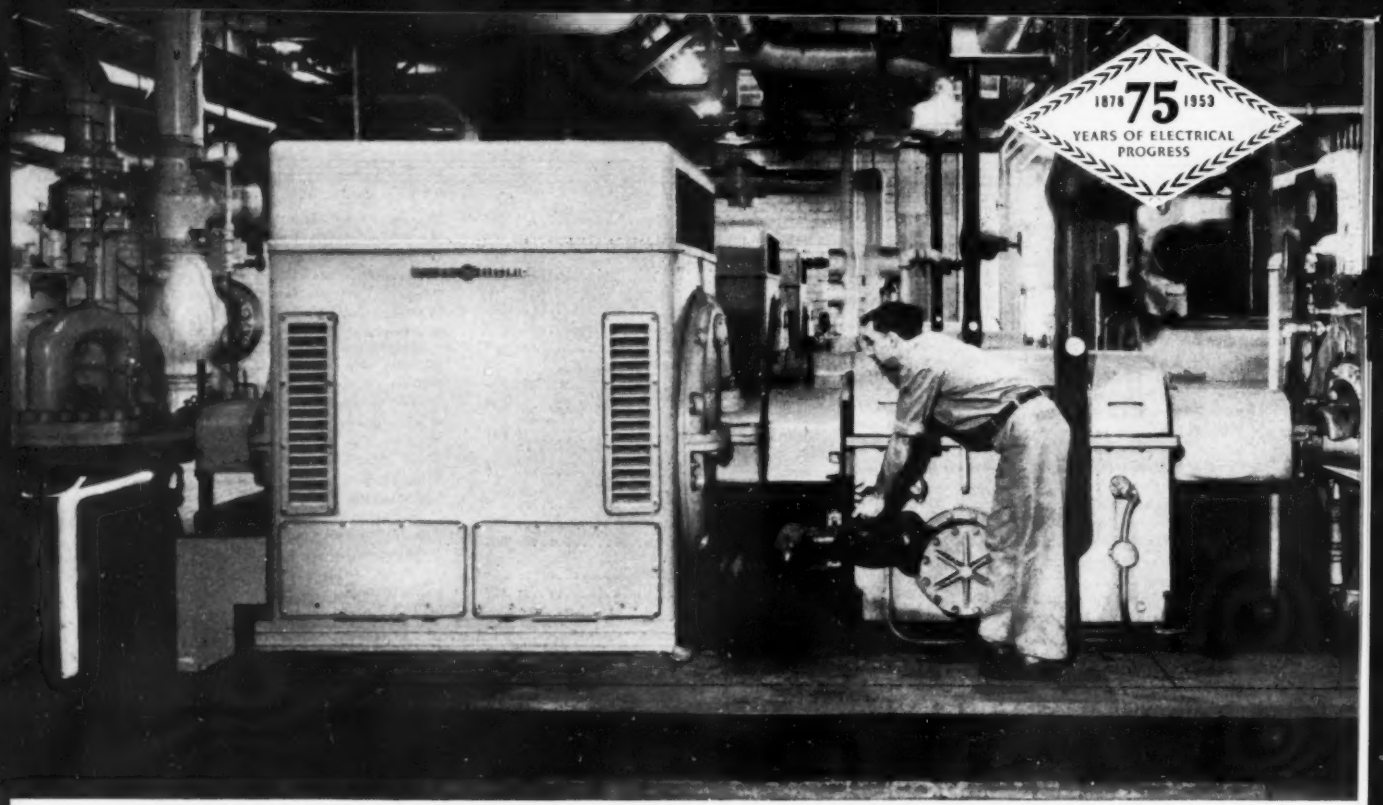

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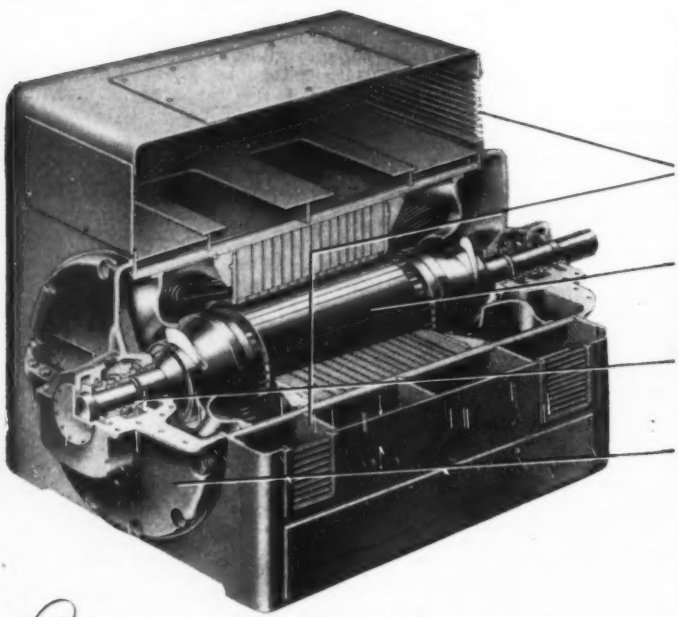

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For more information contact your G-E representative or write for Bulletin GEA-5813 to General Electric Co., Section 753-2, Schenectady 5, N. Y.

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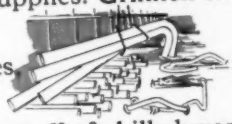
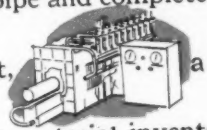
because . . . both quality and economy are guaranteed. Piping is fabricated in Grinnell shops under ideal conditions, with modern equipment, by personnel qualified in all classes of work. Price (determined in advance) includes competent engineering, scheduling and shop sketches, efficient material procurement. Grinnell supplies heat, light, power, water, compressed air, expendable tools and supplies. Grinnell shops have large storage areas for pipe and completed assemblies,  expensive modern equipment,  a permanent staff of skilled workers. Grinnell finances material inventories and payrolls; carries insurance. The customer pays for no waste material or spoilage. Shop fabricated piping is rigidly inspected and tested to meet exacting requirements of customer's specifications and applicable codes. It is cleaned inside and outside and painted. Squared to standard dimensional tolerances, sub-assemblies are erected at the job site more quickly and easily. It all adds up to this . . . shop fabrication by Grinnell guarantees quality and economy.

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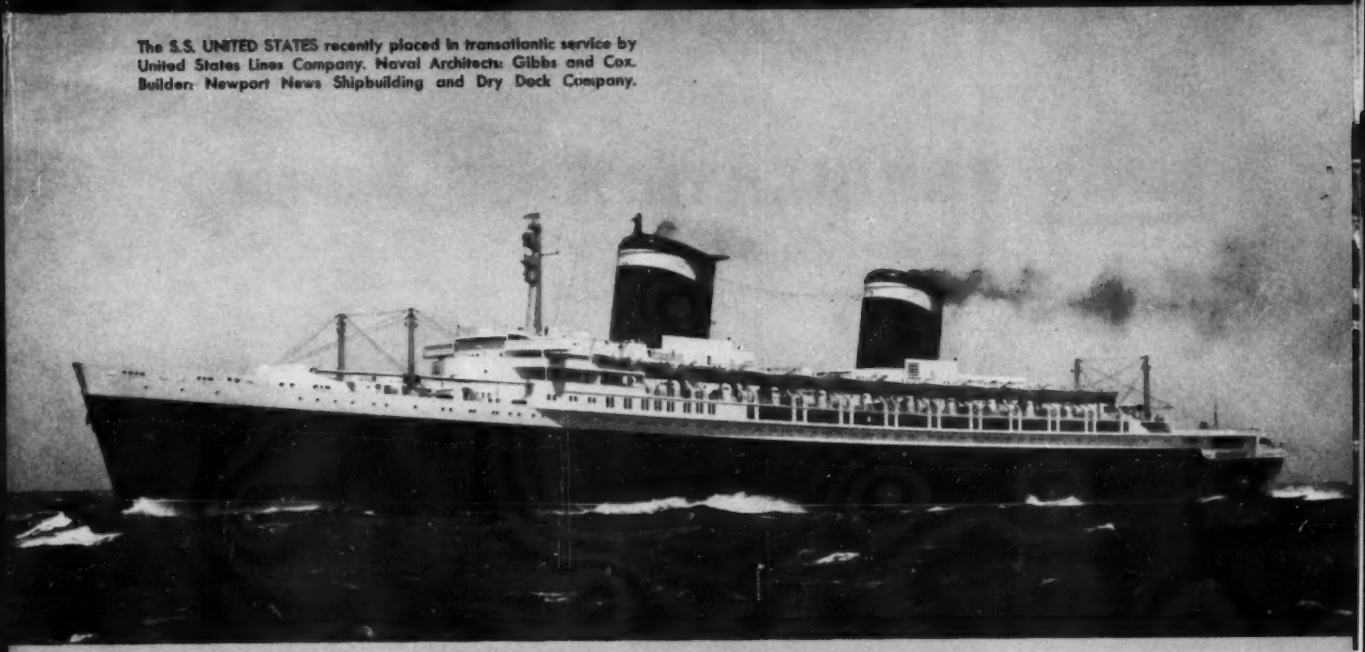

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